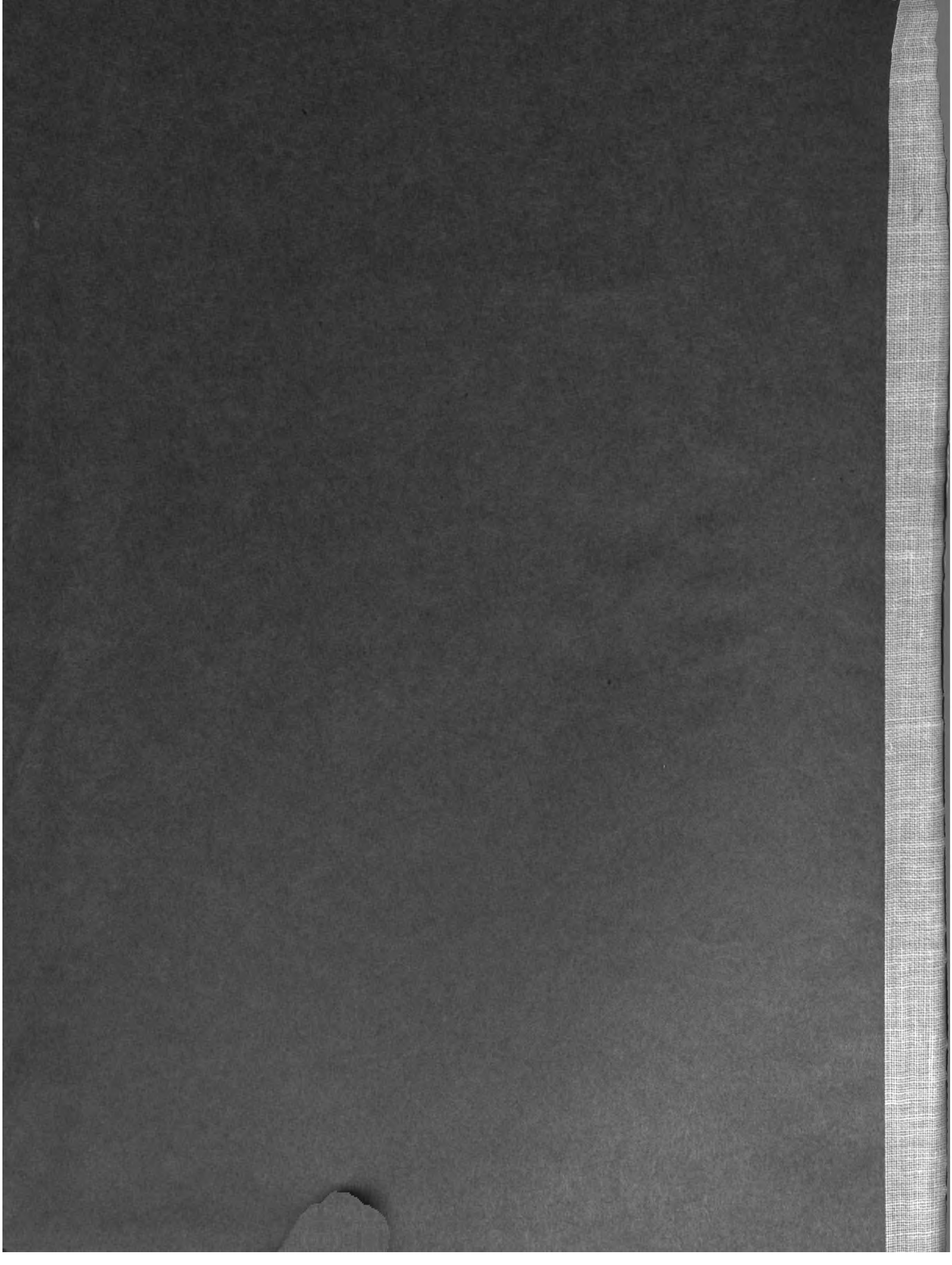


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INDEX TO VOL. XXVIII.

JANUARY 1 to DECEMBER 15, 1925.

INDEX OF AUTHORS.

ANGELIS, G. de, TIZZONI, Prof. G., and CETANNI, Prof. E.—On the modification produced by radium on an emulsion of an adeno-carcinoma of the mouse and its transformation into a curative vaccine, 438

BATTISTINI, TELÉMACO, M.D.—The immunological relationships of the leptospira group of spirochætes, 201
BAYLIS, H. A., M.A., D.Sc.—On *Gongylonema* collected in Italy during October, 1924, with some observations on the genus, 71
—— On the identity of *Gongylonema subtile*, Alessandrini, 361
—— On identity of *Heterakis neoplastica*, Wassink, 362
—— Some notes on nematode parasites found by Dr. Wassink in rats and mice, 316
——, and SAMBON, JULIET, E. B.—Some observations and experiments on *Gongylonema* in Northern Italy. A preliminary note, 413
BEZANÇON, Professor F., and ETCHEGOIN, Dr. E.—Presence of spirochætes in the sputum of tuberculous patients, 228
BLAIR, K. G., B.Sc., F.E.S.—Some notes on the insect intermediate hosts of *Gongylonema*, 76
BLAISDELL, C. BYRON, M.D., and MULLER, HENRY R., M.D.—Studies of yellow fever epidemic in Salvador, C.A., in 1924, 277

CASTELLANI, ALDO, C.M.G., M.D., F.R.C.P.—Beneficial action of raw pancreas in certain cases of sprue. Insulin in cases of sprue complicated with diabetes, 230
—— Further observations on pruritus ani and pruritus vulvæ of mycotic origin, 329
—— Notes on non-gonorrhœal urethrites, 250
—— Notes on three new yeast-like organisms and a new bacillus, with remarks on the clinical conditions from which they have been isolated, 217
—— Observations on some diseases of Central America, 1
—— Phosphorus in the treatment of various diseases, 377
—— DOUGLAS, MACKENZIE, M.D., and THOMPSON, E. T.—Notes on mixed mycotic infections of the bronchi. The mixed monilia + anaeromyces infection, 257
—— and TAYLOR, FRANK E., M.D., B.S., M.A., M.Sc., F.R.C.S.—Further observations on vaginal moniliases, 242
CAWSTON, F. G., M.D.—A contribution to the study of radulæ of fresh-water mollusca, 365
—— A study of some removable causes of unemployment and crime, 441
—— A search for intermediate hosts and a study of their radulæ, 14
—— British Indians and bilharzia disease, 193
—— *Schistosomum ? spindalis* Montgomery in Zululand schoolboy, 406
CETANNI, Prof. E., ANGELIS, G. de, and TIZZONI, Prof. G.—On the modification produced by radium on an emulsion of an adeno-carcinoma of the mouse and its transformation into a curative vaccine, 438
CHRISTOPHERSON, J. B., C.B.E., M.D., and WILSON, FREDA.—Notes by a nurse on the treatment of yaws (framboesia) with novarsan, 424
CONNAL, ANDREW, M.D., D.P.H., D.T.M. & H., and SMITH, E. C., M.D., D.P.H.—Report on fatal case of bacillary dysentery in Nigeria, 379
CRAN, Col. JAMES, O.B.E., M.D.—Results of the Noguchi treatment of the prophylactic measures employed in the 1923 yellow fever epidemic in Belize, 26
CRUTO, Dr. A., and TROCELLO, Prof. E.—On the influence of high temperature on the preservation of insulin, 103

DEEKS, W. E., M.D.—Prevention and treatment of malaria, 21
—— The ætiology of hæmoglobinuric fever, 101
DOUGLAS, MACKENZIE, M.D., THOMPSON, E. T., and CASTELLANI, ALDO, C.M.G., M.D., F.R.C.P.—Notes on mixed mycotic infections of the bronchi. The mixed monilia + anaeromyces infection, 257

EASMON, M. C. E., M.B., B.S.Lond., M.R.C.S., L.R.C.P.—Conditions of medical work in a West African bush station, 128
ETCHEGOIN, Dr. E., and BEZANÇON, Professor F.—Presence of spirochætes in the sputum of tuberculous patients, 228

FACIO, A. A., M.D., and ROJAS, M. D., M.D.—The treatment of hæmoglobinuric fever with caffeine sodio-benzoate, 86
FAUST, E. C., Ph.D., WASSELL, C. McA., M.D., and MELENEY, H. E., M.D.—A study of intensive antimony-therapy in schistosomiasis japonica, 153
FERNANDO, ANTONIO S., M.D., and NICHOLAS-FERNANDO, FELISA, M.D. — Tropical oto-laryngology with special reference to the Philippine Islands, 202
FIALLOS, JUAN MANUEL, M.D.—Observations on Castellani's fermentation phenomenon, 426. *See also* correction on p. 443

GHOSH-DASTIDAR, S. K., M.B., D.T.M.—Treatment of cholera and its complications, 261

HASLAM, J. F. C., M.C., M.D., D.P.H., M.R.C.P.E.—Observations on experimental use of fish indigenous to British Guiana for control of mosquitoes breeding in vats, tanks, barrels and other water containers, 284
HEWETSON, W. M., M.B., D.P.H.—The ætiology of blackwater fever, 88, 105

INGRAM-JOHNSON, R. E., L.R.C.P.Edin., &c. — Dengue *v.* malaria, 126

JAMISON, S. CHAILLE, M.D., and JOHNS, F. M., M.D.—A note on treatment of amœbic dysentery with stovarsol, 378
JEWELL, N. P., F.R.C.S.I., M.D.—Three cases of Castellani's endemic funiculitis in Kenya Colony, 137
JOHNS, F. M., M.D., and JAMISON, S. CHAILLE, M.D.—A note on treatment of amœbic dysentery with stovarsol, 378

LEBLANC, T. J., A.B., M.S.P.H., C.P.H., Sc.D.—Studies of yellow fever in Vera Cruz in 1920-1921, 169

MCCULLOCH, W. E., M.B., Ch.B.Aberdeen.—Relapsing fever in Northern Nigeria—a study of 300 cases, 332
MELENEY, H. E., M.D., FAUST, E. C., Ph.D., and WASSELL, C. McA., M.D.—A study of intensive antimony-therapy in schistosomiasis japonica, 153
MELLO, Lieut.-Col. FROILANO DE. — Some remarks upon *Spirochæta bronchialis* Castellani, and bronchial spirochætosis, 237
MENDELSON, RALPH W., M.D., D P.H. — Some interesting diseases observed in clinic of Bangkok Central Hospital, 393
MULLER, HENRY R., M.D., and BLAISDELL, C. BYRON, M.D.—Studies of yellow fever epidemic in Salvador, C.A., in 1924, 277

NEWHAM, H. B., C.M.G., M.D., M.R.C.P.—Pathology of *Clonorchis* infection of pancreas, 437
NICHOLAS-FERNANDO, FELISA, M.D., and FERNANDO, ANTONIO S., M.D.—Tropical oto-laryngology with special reference to the Philippine Islands, 202

NICOLE, J. ERNEST, L.M.S.S.A.Lond., and STEEL, JOHN P., M.B., Ch.B.Edin.—Acquired immunity to malarial inoculation, 428
NOGUCHI, HIDEYO, M.D., M.S., Ph.D., Sc.D.—Yellow fever research, 1918-1924: a summary, 185

ORLEMAN, MABELLE, and STILES, Prof. C. W.—The cestode genus *Hydatigera* Lamarck, 1816, species *Reditœnia* Sambon, 1924, 249

PAGNIER, A., M.D., and SCHRUMPF-PIERRON, P., M.D.—A clinical study on malaria in the Near-East and in Europe, 117

RAMSAY, G. C., O.B.E., M.D.Edin., D.T.M.&H.Eng.—The influence of climate and malaria on yaws, 85
RIDLEY, H. W., C.M.G., F.R.S.—Use of iodine in beriberi, 102
ROBERTSON, ANDREW, M.B., Ch.B., and THOMSON, J. G., M.A., M.B., Ch.B.—A note on the flagellates of anophelines and culicines previously mentioned in the literature with a description of a crithidial form in a new host *Anopheles umbrosus* from the Federated Malay States, 419
—— —— Notes on cultivation of certain amœbæ and flagellates of man, using technique of Boeck and Drbohlav, 345
—— —— The cysts of *Tricercomonas intestinalis* Wenyon and O'Connor 1917 found in human fæces, 223
ROJAS, M. D., M.D., and FACIO, A. A., M.D.—The treatment of hæmoglobinuric fever with caffeine sodio-benzoate, 86
ROSS, G. A. PARK, M.D., D.Ph.—Fly-proof latrines for coloured persons, 231

SAMBON, JULIET, E. B., BAYLIS, H. A., M.A., D.Sc., and T. C. PAN, M.B., Ch.B.—Some observations and experiments on *Gongylonema* in Northern Italy. A preliminary note, 413
SAMBON, LOUIS WESTENRA, M.D., F.Z.S.—Gongylonema, 313
—— Researches on the epidemiology of cancer made in Iceland and Italy (July-October, 1924), 39
SCHRUMPF-PIERRON, P., M.D., and PAGNIER, A., M.D.—A clinical study on malaria in the Near-East and in Europe, 117
SHAW-MACKENZIE, J. A., M.D.Lond.—Blood- and tissue-changes in cancer, with reference to diagnosis and treatment, 297
SMITH, E. C., M.D., D.P.H., and CONNAL, ANDREW, M.D., D.P.H., D.T.M.&H.—Report on fatal case of bacillary dysentery in Nigeria, 379
SPAAR, ERIC C., M.D., B.S., B.A.Lond., M.R.C.P.—Some observations on common endemic fevers of Ceylon, 349
SPENCER, H. A., M.R.C.S., L.R.C.P.Lond.—Lightning stroke and electric storms in the tropics, 138
—— Prophylaxis in malaria, 207
STEEL, JOHN P., M.B., and NICOLE, J. ERNEST, L.M.S.S.A. Lond.—Acquired immunity to malarial inoculation, 428
STILES, Prof. C. W., and ORLEMAN, MABELLE.—The cestode genus *Hydatigera* Lamarck, 1816, species *Reditœnia* Sambon, 1924, 249

TAYLOR, FRANK E., M.D., B.S., M.A., M.Sc., F.R.C.S., and CASTELLANI, ALDO, C.M.G., M.D., F.R.C.P.—Further observations on vaginal moniliases, 242
THOMPSON, E. T., CASTELLANI, ALDO, C.M.G., M.D., F.R.C.P., and DOUGLAS, MACKENZIE, M.D.—Notes on mixed mycotic infections of the bronchi. The mixed monilia + anaeromyces infection, 257
THOMSON, J. G., M.A., M.B., Ch.B., and ROBERTSON, ANDREW, M.B., Ch.B.—A note on the flagellates of anophelines and culicines previously mentioned in the literature with a description of a crithidial form in a new host *Anopheles umbrosus* from the Federated Malay States, 419
—— —— Notes on cultivation of certain amœbæ and flagellates of man, using technique of Boeck and Drbohlav, 345
—— —— The cysts of *Tricercomonas intestinalis* Wenyon and O'Connor 1917 found in human fæces, 223
TIZZONI, Prof. G., CETANNI, Prof. E., and ANGELIS, G. de.—On the modification produced by radium on an emulsion of an adeno-carcinoma of the mouse and its transformation into a curative vaccine, 438
TROCELLO, Prof. E., and CRUTO, Dr. A.—On the influence of high temperature on the preservation of insulin, 103
TROUT, CHARLES LEWIS, M.D.—The treatment of blackwater fever, 225

VISWALINGAM, A., L.M.S.—Granuloma venereum, 302

WASSELL, C. McA., M.D., MELENEY, H. E., M.D., and FAUST, E. C., Ph.D.—A study of intensive antimony-therapy in schistosomiasis japonica, 153
WILSON, FREDA, and CHRISTOPHERSON, J. B., C.B.E., M.D.—Notes by a nurse on the treatment of yaws (frambœsia) with novarsan, 424

GENERAL INDEX.

A

ABSTRACTS :—

Ankylostomiasis inquiry in Madras, report, 82
Appendicitis, *Oxyuris vermicularis* as causative factor in, 309
Castellani's glycero-vaccine, agglutinin formation following use of, 273
Creeping disease (gnathostomiasis) in China, two new cases of human, with note on infection in reservoir hosts in China area, 358
Epidemic disease, prevalence of, and port health organization and procedure in the Far East, 18
Goitre in Honolulu, absence of endemic, 182
Hæmoglobinuric fever in the canal zone, its ætiology and treatment, report of, 34
Hookworm infection as influenced by wearing of shoes, 356
Night soil, utilization of solar light and heat in treatment of, 291
Plague in Hong Kong, outline of history, 388
Sleeping sickness, prophylaxis, 256
Tropical technique, hints, 371

ANNOTATIONS :—

Accuracy of measurement of small volumes of fluid with a capillary pipette, 146
Acne varioliformis, experimental, 212
Acriflavine, action on blood and certain tissues of rabbits, 290

ANNOTATIONS—*continued.*

Addison's disease, studies, 271
Adenitis, radiotherapy in treatment of tuberculous cervical, 409
Ætiology of jagziekte, studies on, 431
Alastrim, 255
Aleukæmic leukæmia with multiple skin tumours, 429
Alopecia, persistent, in rabbits, production of by X-rays, 450
Amœbiasis cutis. With a survey of the medical literature to date, 142
——, experimental, in cats from acute and chronic human cases, 165
——, extra-intestinal, 15
——, some clinical and laboratory aspects with preliminary report on yatren treatment, 387
——, treatment by oral administration of stovarsol, 325
Amœbic liver abscess with report of two cases occurring in Connecticut, 135
Amyloid casts, question of existence, 290
Anæmia associated with sprue syndrome, *Monilia psilosis* Ashford in severe, 342
Anæsthesia produced by intra-arterial infection of apothesine, 324
Anthelmintic, factors which should determine selection in a geographical area, 324
Anticryptogamic action of fluosilicate of soda and of hydrofluosilicic of acid in coagulation of india-rubber, 370

ANNOTATIONS – *continued.*

Antigenic properties of solutions of pneumococcus, 446
Anti-leprosy treatment, I, complaints of patients, 270
—— ——, III, complaints of patients, 321
Antirabic injections, some lesions of the nervous system provoked by, 255
—— treatment, preservation of marrow, 254
Antityphoid vaccination, nervous and mental complications, 115
Antivenomous serum, effect of storage on potency of, 323
Appendectomy, diagnostic errors leading to uncalled for, 149
Arcella polypora, interactions of protoplasmic masses in relation to the study of heredity and environment, 99
Argentine tumours of appendix and small intestine, 447
Arsphenamin poisoning, clinical and experimental investigation, 265
Arthritis and rheumatoid conditions, alleged rôle of lactic acid, 145
Ascaris, question of human and pig, 214
Bacillus bronchisepticus and *Bacterium lepisepticum*, association of, with rabbit snuffles, 324
—— *coli* in water analysis, new medium for differentiation, 433
—— *dysenteriæ*, note on viability, 387
—— *typhosus*, viability in oysters during storage, 387
Bacteria, penetration through capillary spaces, 234
Bacterial agglutinin, liver as source of, 308
Beriberi from diet of raw starch, 410
Biology of *Anopheles superpictus*, study of, 451
Blackwater fever, some observations, 110
Buffered solution for perfusion of isolated organs, 342
Buried glass capillaries of radium emanation, action on plant and animal tissues, 213
Carcinoma of lungs, primary, 271
C. diphtheriæ and other members of the genus *Corynebacterium* with special reference to fermentative activity, 233
Cell-inclusions, occurrence in rabbit cornea after inoculation with vesicular contents and naso-pharyngeal secretion of varicella cases, 200
Chaulmoogra and allied preparations, chemotherapeutic experiments, 29, 146, 447
Cholera toxin, nature and pharmacological action of, 134
—— vaccination; its effectiveness as evidenced by presence of antibodies in blood of vaccinated persons, 288
Clonorchis infection in China, some recent aspects of epidemiology of, 406
—— *sinensis*, comparative study, 409
Coconut oil, detection of traces of alkali or soap in refined, 146
Colds, value of chlorin in treatment of, 326
Colon bacillus infections, 381
Coma, juvenile diabetic, with insignificant ketonuria, and with a large amount of acetone in the spinal fluid, report of a fatal case, 82
Comparative study of action on pneumococcus of bile-acids and unsaturated fatty acids found in bile in form of soaps, 450
Congenital ectodermal defect, 212
—— ichthyosiform erythroderma, 369
Cosmetics, 322
Crescent and the red cell, 143
Crescents, relative number of male and female, 144
Croonian lectures on researches on leprosy and their bearing on the treatment of tuberculosis, 264
Debab trypanosomiasis of the dromedary, treatment, 211
Dengue fever, studies upon the etiology, 232
Dermatitis in association with disease or injury of peripheral nerves, 369
—— produced by Portuguese man-of-war, 369
Diabetes, cephalandra indica in, 322
——, intarvin, 371
—— mellitus, 199
Diabetic retinitis, 447
Diagnosis, multiple electrical stethoscope and electrical filters as aids, 147
Diphtheria carriers, epidemiological importance, 323
—— of skin, 322
Diseases of the skin, calcium content of the blood, 148
Disinfection of eating utensils in U.S. Army, study of methods, 431

ANNOTATIONS—*continued.*

Dochez scarlet fever antitoxin in thirty-one cases, 386
Dracontiasis, studies in, 33
Dwarf tape-worm (*Hymenolepis nana*), experimental study on development, 433
Dye (brilliant vital red), fate of an intravenously-injected, with special reference to its use in blood volume determination, 309
Dysenteries of Cochin China, 385
Dysentery, effects of "*Castela nicholsoni*" in treatment of chronic amœbic, 269
——, further observations on latent, 33
——, therapy of amœbic, 252
Ear, painful nodular growth, 272
Ectopic gestation in Chinese women, 115
Effect of various agents, 326
Encephalitozoon cuniculi as kidney parasite in the rabbit, 144
Endamœba histolytica, cultivation, 341
Endo's medium, preparation of, 447
Epidemiology in Libia, notes on ocular, 165
Epilepsy, ketogenic diet in, 323
——, pathogenesis, 367
Epinephrine, factors concerned in the polycythemia produced by the subcutaneous injection of, 145
Equine infection, existence of, due to *Trypanosoma marocanum* on the borders of Algero-Morocco, 211
Exophthalmic goitre, iodine in, 212
Fallacy of test for lactose fermenters as indication of fæcal pollution of waters, 433
Familial blood dyscrasias, 214
Filaria recondita Grassi, observations on the morphology and life cycle, 82
Filariasis, yaws and intestinal helminthic infections in Cook Islands, observations, with notes on breeding habits of *Stegomyia pseudo-scutellaris*, 432
Flagellar and somatic agglutination, effect of heat on, 195
Flagellate infections, investigations, 98
Formol-gelification in dromedaries and bovine animals, on the subject of, 211
Fungicidal activity of certain volatile oils and stearoptens, 325
Fusiform bacilli and spirochætes, studies, 195
Gangrene, localized, following hypodermic administration of calcium chlorid, 386
Gangrenous affections of fusospirillar association by an antispirillar vaccine, vaccinotherapy in, 386
Gasserian ganglion, alcoholic injections, 213
Gastric achylia and simple and pernicious anæmia, relations between, 199
—— lesions, occurrence in rats, 199
—— secretion, influence of different kinds of oil, introduced into the rectum, 234
—— ulcer, treatment by method of duodenal alimentation, 325
Genito-urinary disease, mercurochrome-220 soluble, 322
Giardia and *Chilomastix* from monkeys, *Giardia* from the wild cat, and *Balantidium* from the sheep, 213
Glandular fever, laboratory findings in an epidemic, 211
Gonococcal infection, cutaneous, 144
Gonococcus and pneumococcus, notes on selective media for, 354
Goundou, 432
Granuloma inguinale: including a series of cases illustrating some points in prognosis and treatment, 142
Hæmolytic streptococci, contribution to biological study on, 134
Hæmophilia, 327
Hæmoptysis onset in tuberculosis, significance, 321
Hay fever, study of two hundred and two cases, 266
Heartwater, studies on etiology, 369, 370
Height, weight and chest measurements of Mongolian peoples, with especial reference to Southern Chinese, 271
Helminthiasis, eradication from Egyptian army, 268
Hemolytic proteus bacillus, study of, 449
—— streptococci, classification of, by the precipitin reaction, 17
Hepatosis (or tropical abscess of liver), 135
Hernia of the diaphragm, early diagnosis of true, 212

ANNOTATIONS – *continued.*

Herpetomonad flagellates in the latex of milkweed in Maryland, 181
Hexyl resorcinol, 410
Hookworm disease, control of, in South Alabama, 81
—— ——, experiments in the treatment of, with carbon-tetrachlorid and ascaridol, 82
—— —— in Colombo, investigations on the epidemiology, 81
—— ——, severity in a Chinese group, tested by hæmoglobin readings for anæmia, and egg counts for degree of infestation, 323
—— —— treatment with combination of carbon-tetrachloride and oil of chenopodium, 182
—— —— —— —— —— mixture of carbon tetrachloride and ascaridol, 354
——, effect of carbon-tetrachloride on the egg-laying powers of the female, 182
Human creeping disease (gnathostomiasis), two new cases in China, with note on infection in reservoir hosts in China area, 319
—— intestinal protozoa in Peking, China, a survey of, 451
Hydatid parasite (*Tænia echinococcus*) in the pig, histogenesis of, 255
Hypoglycemia, sugar-content of blood in runners following Marathon race, with special reference to prevention, 408
Immunization of rabbits to cutaneous infections with staphylococcus infection, 450
——, possibility, of tissues of nose, throat and ear by use of vaccines applied locally, 290
Immunological reactions of the isolated carbohydrate and protein of pneumococcus, 446
Inguinale hernia: report of 100 operations on Korean patients, 451
Injuries and diseases in Australia attributable to animals (except insects), 133
Intestinal parasites of man, observations on North China, 181, 384
Intramuscular injections, local effects produced in the tissues by, 32
Intratracheal injections of type I pneumococcus, effect of fatigue upon susceptibility of rabbits to, 307
Ivy poisioning, 325
Jaundice, chronic hereditary and familial hæmolytic, 325
——, determination of phenolsulphonephthalein in urine, 197
——, reaction of liver to phenol-tetrachlorphthalein in early obstructive, 146
Jute dermatitis, 32
Kala-azar endemic areas, significance of splenic-index, 324
——, final report on the use of urea stibamine, 135
—— on Pusa estate, note on incidence, 355
—— prevalence in Calcutta, comparative study of environment associated with, 309
Kidney, concentrating capacity, 145
Korsakoff's psychosis and typhoid fever, 115
Lafah in Tripolitania, 384
Lathyrism—I, studies on, 309
Leprosy, epidemiological study, 386
—— in New York City, 143
——, preparation of hydnocarpus esters and their use in, 32
——, report on the investigation of a number of cases at Nauru, Central Pacific, 147
——, treatment in Ceylon, 98
Leucocyte inclusions, disease of fowls in Palestine characterized by, 268
Leukæmia cutis, universal, 148
Leukocytes, determination of resistance of, 82
Leukoderma following dermatitis venenata (*Rhus toxicodendron*), 445
Leutic precipitation test, dissolution of the precipitates produced by the fresh serum, 133
Lichenoid sarcoid: an unusual case, 443
Liver, amœbic abscess, 367
—— fluke, human, in Korea and note on immediate hosts of liver-fluke in China, 92
—— function test, a new, 147
Lupus erythematosus, 369
Malaria among Chinese university students, 270
—— at Madagascar, fight against, 307
——, further observations made during treatment of general paralysis, 355

ANNOTATIONS—*continued.*

Malaria in communities living under hyper-endemic conditions, mechanism of immunity against, 33
——, incubation period of benign tertian, 432
—— infection as it occurs in late pregnancy, 433
—— in rural settlements in Palestine, 168
—— —— Suriname, 145
—— —— the Kirkuk division of Northern Mesopotamia during 1923, 385
——, mercurochrome in treatment of chronic, 354
——, observations on inoculated, 308
—— parasites in placental blood, 268
Malignant tumour of the rabbit, studies based on, 200
Mastigina hylæ (Frenzel) from intestine of tadpole, morphology, 433
Melanosis after arsenobenzol, 272
Melioidosis, two cases, 199
Meralgia paræsthetica: relation to ostearthritis of spinal vertebræ, 410
Mercurochrome-220 soluble and gentian violet, 267
Mercury absorption from the skin, microscopic study, 181
Micro-organisms, group, transmitted hereditarily in ticks and apparently unassociated with disease, 308
Microsporidia parasitic in mosquitoes, studies, 213
Mitral stenosis without rheumatic fever in North China, 97
Mosquito breeding in specific places, 211
—— ——, California rice-fields and, 444
Mosquitoes and coconut palms, 234
Mycetoma in Tunisia, four new cases, 235
—— report of four cases, 140
Mycorrhiza plants, *Calluna vulgaris*, nutrition, 367
Mycotic paronychia and dermatitis, 272
Myeloid leukæmia of the skin, 99
Neo-arsphenamin, treatment with intraperitoneal injection, 410
Nephritis, concentration of plasma proteins, 146
Neurosyphilis, clinical and serological studies, with tryparsamide therapy, 387
——, results secured by standard methods of treatment, 198
——, tryparsamide in treatment of, 197, 355
—— —— treatment, 370
Night soil, utilization of solar light and heat in treatment of, 291
Nitritoid crisis following intravenous injection of arsenicals, cause of, 446
Nodosites juxta-articulaires, 369
Obscure lesions, effects on organ weights of apparently normal rabbits, 386
Orchidoma or orchidoblastoma of the horse, 143
Orchitis of the rabbit, experimentally produced by inoculation with the spirochæte of rat-bite fever, 144
Ornithobilharzia odhneri n. sp. from Asiatic curlew, notes on, 369
Oxygenation and starvation, effects on symbiosis between termite, termopsis and its intestinal flagellates, 369
Paralysis, general, treatment by malaria, 271
——, treatment of general by inoculation with malaria, 267
Paratyphoid-enteriditis infection of white mice, microbic virulence and host susceptibility, 343
—— fever, report of epidemic in patrons of a cafeteria, 198
—— outbreak, certified milk-borne, 307
Parenchymal rôles in pulmonary tuberculosis, 447
Parsa hilarata Staudinger, some observations and experiments on irritating properties of larva, 269
Pathogenic fungi, reaction to ultra-violet light and rôle played by pigment in this reaction, 200
Penetration of fruits and vegetables by bacteria and other particulate matter, and the resistance of bacteria, protozoon cysts and helminth ova to common disinfection methods, 449
Peptic ulcer, focal infection, 272
Pine oil films, toxic action of oil films upon mosquito larvæ, with particular reference to, 269
Plague, bactericidal power of blood of rats as measure of their immunity to, 355
—— fleas, with special reference to Milroy lectures, 1924, 408
—— investigations in Egypt, report on, 34
——, production of immunity by vaccine, 134
—— transmission through ectoparasites of tarabagan, 307
Plasmodium falciparum, some morphological features, 143

ANNOTATIONS—*continued.*

Pneumococcus immunity, significance of anaphylaxis, 144
—— infections, blood platelets in, 18
—— pneumonia, experimental production in mice by inhalation method, 199
—— protein, production and significance of cutaneous allergy to, 144
——, studies on oxidation and reduction by, 17
Pneumonia in mice, pathology of experimental pneumococcus, 234
——, lobar, notes on therapeutic value of pneumococcus antibody solution subcutaneously administered in, 290
——, pathology, caused by bacillus influenzæ during an inter-epidemic period, 214
Poliomyelitis, anterior, in Kansas, study of the 1923 epidemic, 143
Proteus hæmotoxin, 449
Pseudo-malarial attacks in typhoid fever, 97
Psoriasis, monilia as possible etiologic factor, 326
——, treatment by intravenous injections of salicylate of soda, 142
Pulmonary infection with the spirochætæ and fusiform bacilli, 115
—— plague, investigations, 211
—— tuberculosis in Cochin China, investigations, 256
Pyrubrin, a red water-soluble pigment characteristic of *B. pyocyaneus*, 450
Quinine, concentration in circulating blood, 354
Rabies during the last ten years, works on, 148
Radium-therapy in dermatology, 445
Rat-bite fever with special reference to its ætiological agent, 291
Raynaud's disease complicated with gastric ulcer, 386
—— ——, skin capillaries, 271
Reaction product which inhibits reproduction of the trypanosomes in infections with *Trypanosoma lewisi*, with special reference to its changes in titre throughout the course of infection, 266
Reinoculations in infection due to a *M. melitensis*, especially after the experimental malady of the guinea-pig, 254
Relation of insect herpetomonad and crithidial flagellates to Leishmaniasis, studies on.—I, 448; II, 448; III, 448
Resistance to mildew in œnothera, biochemical study, 343
Respiratory infections of rabbit, epidemiological studies, 272
Rheumatic fever, attempts to transmit to rabbits and guinea-pigs, 135
River fever (Tsutsu-gamushi disease), possible incidence in the Central Yangtze Valley, 97
Rocky Mountain spotted fever, 265
—— —— —— —— in the blood, identification of organism, 266
Roentgen-ray dermatoses, chronic, as seen in the professional man, 267
—— treatment in bronchial asthma and chronic bronchitis, 449
Salvarsan treatment, effect of alcohol and nicotine, 133
Saponification of bodies in the United Provinces of Agra and Oudh, 211
Sarcoma, multiple hæmorrhagic, of Kaposi, 291
Scarlet fever and diphtheria patients, intradermal salt solution test, 178
—— ——, institutional outbreak, 321
—— ——, results with skin test for susceptibility to, 326
—— —— II, studies, 255
Schistosoma japonicum and *S. hæmatobium*, reactions of miracidia in presence of their intermediate hosts, 387
Sclerosis, multiple, treatment with silver salvarsan, 168
Scrofuloderma gummosa, 148
Shoe dye poisoning, 322
Sickle cell anæmia with necropsy, a case, 214
Sigma reaction for syphilis, observations on, 445
Silver arsphenamin, relation of, to the involuntary nervous system and to the so-called nitritoid crisis, 135
Skin infection of rabbits with hæmolytic streptococci isolated from patient with erysipelas, 307
—— reactions to simultaneous treatments with radiant and soft X-rays, 308
Sleeping sickness, report on investigation into epidemiology, in Central Kavirondo, Kenya Colony, 270
Small-pox, blood in purpuric, 309

ANNOTATIONS—*continued.*

Splenomegaly, typical case, 304
Sprue, rôle of *Monilia psilosis* (Ashfordi) in experimental, 133
——, value of estimation of ionic calcium of serum in diagnosis of, and as gauge of process, 267
Stomatitis, autumn, 254
Streptococci and pneumococci, serological relationship among and between, 145
Streptococcus group, precipitation and complement-fixation reactions with residue antigens in the non-hæmolytic, 195
Sugar content of cerebrospinal fluid and its relation to blood-sugar, 289
—— —— normal, of blood and sugar tolerance test, some observations, 342
Sulpharsphenamin, chemotherapy, 200
Syphilis, clinical studies of Kahn reaction, 267
—— —— —— on the Kahn reaction for, 213
—— —— value of bismuth in the treatment of, 17
——, contributions to pathologic anatomy, 368
—— effects of non-specific protein therapy, 148
—— experimental, of rabbit, therapeutic action of potassium iodide, 321
—— incidence of *Spirochæta pallida* in cerebrospinal fluid during early stage, 198
—— in rabbits, observations on possibility of cure with arsphenamine, 343
—— latent, 290
——, prophylaxis of congenital, 17
—— reinfection, 198
——, relation of natural anti-sheep hemolysin of human serums to Kolmer's quantitative complement-fixation test for, 233
——, serological studies of experimental, 215
——, specificity of sero-reaction in experimental, with special reference to "Sachs-Georgi" reaction, 409
——, stability of desiccated beef heart-muscle powder for preparation of antigens for conduct of complement fixation tests, 233
——, value of flumerin in treatment of, 326
——, Vernes flocculation test, 381
Syphilitic aortic insufficiency, 198
Tapeworms, treatment, 168
Termite castes, feeding habit, and its relation to their intestinal flagellates, 367
Tetanus cured by large doses of serum, 133
Tick paralysis in human beings, death from, 32
Tissue resistance and cause of permanent acquired immunity, 200
Toxicity of oxygen for protozoa *in vivo* and *in vitro*: animals defaunted without injury, 368
Trichomonas from guinea-pig, study, 325
—— *intestinalis*, pathogenicity, 388
—— *vaginalis* Donné, 268
Trypanosomiasis in Palestine, experimental study, 214
Tuberculosis of guinea-pig, influence of "Diaplyte" antigen of Dreyer on, 272
—— of vagina, 410
—— incidence and climate in India: rainfall and west winds, 143
—— in India in general and Bengal in particular, some etiological factors, 115
Turpentine industry, survey for possible larvicidal instances, 319
Typhoid bacilli, viability in shell oysters, 321
—— fever, oleum morrhuæ in, 115
Typhus fever, case resembling endemic, 181
Undulant fever, rôle of domestic cow in epidemiology, 266
Urticaria solaris, 368
Virus encephalitis, contributions to pathology of experimental, 273, 307
Vitamin content of banana, 269
Vitamins, relation to reaction induced by coal tar in tissues of animals, 370
Wadi Halfa quarantine, 98
Wassermann and Khan tests, a comparison, 443
—— —— effect of bismuth on Wassermann reaction in patients unresponsive to arsphenamin, 446
—— test, 148
Yeast absorbed complement, activation with heated sera, 266
Yellow fever, use of fish in control of, 411

Amœbæ and flagellates of man, notes on cultivation of certain, using technique of Boeck and Drbohlav, 345
Amœbic dysentery, note on treatment with stovarsol, 378
Anaeromyces infection, mixed monilia +. Notes on mixed mycotic infections of the bronchi, 257
Anopheles umbrosus from Federated Malay States, note on flagellates of anophelines and culicines previously mentioned in literature with description of crithidial form of new host, 419
Antimony-therapy in schistosomiasis japonica, study of intensive, 153

B

Bangkok Central Hospital, Clinic, some interesting diseases observed, 393
Belize, results of the Noguchi treatment of the prophylactic measures employed in the 1923 yellow fever epidemic in, 26
Beriberi, use of iodine in, 102
Bilharzia disease, British Indians and, 193
Blackwater fever, ætiology, 88, 105
—— ——, treatment, 225
British Guiana, observations on experimental use of fish indigenous for control of mosquitoes breeding in vats, tanks, barrels and other water containers, 284
Bronchial spirochætosis, some remarks upon *Spirochæta bronchialis* Castellani, and, 237

C

Caffeine sodio-benzoate, treatment of hæmoglobinuric fever with, 86
Cancer, blood- and tissue-changes with reference to diagnosis and treatment, 297
——, researches on the epidemiology, made in Iceland and Italy (July-October, 1924), 39
Castellani's endemic funiculitis in Kenya Colony, three cases, 137
—— fermentation phenomenon, observations, 426
Central America, observations on some diseases of, 1
Ceylon, some observations on common endemic fevers, 349
Cholera, its treatment and complications, 261
Climate, influence of, and malaria on yaws, 85
Coloured persons, fly-proof latrines for, 231

CORRESPONDENCE :—

Bat roost, Mitchell Lake, San Antonio, Texas, 392
Bilharzia parasites, 276
Cancer, reported in dogs successively housed in the same kennel, 236
Diseases of Central America, 115

Cultivation, notes, of certain amœbæ and flagellates of man, using technique of Boeck and Drbohlav, 345

CURRENT LITERATURE :—

Abdominal conditions, treatment of some with inflation of oxygen gas, 412
Adhatoda vasica, preliminary note on pharmacology and therapeutics, 391
Ainham, case in right leg, 360
Air embolism, experiments, 412
Aldehyde test in *Schistosomum hæmatobium* infection, 20
Amœbæ of man, chytridial parasites of, 150
Amœbiasis, urinary, 360
Amœbic abscess of liver, 452
Ankylosis of joints, 84
Ankylostomiasis, existence in Turkey, 275
Anthelmintic, notes on carbon-tetrachloride as an, 183
Anthrax, bacterial, in a severely infected area, conclusive experiments on intradermovaccination, 100
Antimalarial campaign at Gagri in 1923 and 1924, 344
Antimeningococcal infection in Belgian Congo, experiments, 274
Antiplague vaccination by mouth in man, experiments of, 274
Antituberculosis vaccination of infants in Cochin China and Cambodia, first experiments, 344
Asthma in Tangiers, frequency, 344
——, treatment, 184
Bacillus flagellatus and *Spirochæta omeliansky* n. sp., 295
Basal metabolism of young man as affected by a normal tropical residence of one year, 451

CURRENT LITERATURE—*continued.*

Batrachia which harbour and propagate certain intestinal flagella of man, 375
Bayer 205 in the treatment of human trypanosomiasis, 36
Beriberi in Annamites of Cochin China, arterial tension and blood viscosity, 360
—— investigations. Avitaminosis and infection in experimental disease of the young pig due to *Bacillus asthenogenes*, 151
Bilharziosis in French West Africa, 216
——, some considerations on the treatment by emetic, 216
Blastocystis hominis, pathogenic rôle, 236
Blastomycosis of lacrymal ducts, isolation of the pathogenic agent, 236
——, on subject of, 236
Blue tongue in French West Africa, introduction, 235
Blood-serum globulin in leprosy, 452
Box-stove, 215
Bronchomycosis due to sterigmatocystis in Urandi, 36
Carbon tetrachloride to cats, toxicity, 411
Cataract extraction, 392
—— ——, choroidal hæmorrhage following, 296
Cephalandra indica, observations on antidiabetic properties, 296
Cerebrospinal meningitis, case due to Pfeiffer's bacillus, 359
Chilomastix mesnili, pathogenic rôle, 236
—— ——, secondary infection of uterus post partum by, 275
Cholera epidemic in Bombay, some observations on the, 20
—— epidemics in Jheria coal-fields, investigation into origin, 184
—— in Bengal: past and present, 327
—— stools, cellular elements in, and their relative importance in diagnosis of the disease, 328
—— treated by various methods, notes on a few cases of, 20
——, treatment by cresol and acid, 275
Clou de Biskra, observed in neighbourhood of Algiers, 275
Coccidiosis, human intestinal, due to *Isospora belli*, 376
Coccidium persicum, nov. sp. parasite of the biliary tract of *Tropidonotus natrix*, var. *persa* Pallas, 150
Dementia præcox, observations, 411
Dercum's disease, case of, affecting whole body except face, hands, and feet in native women of Morocco, 274
Diabetes and insulin treatment in Bengal, 312
Digitalis in Bengal, clinical studies, 275
—— preparations in the Tropics, variations in the potency, 184
Diseases of heart and aorta as met with in Bengal, preliminary observations on acquired, 327
Disinfectants on microbes, action: an interesting phenomenon, 412
Disinfestation of houses by fumigation with cresol, note on, 312
Draconculosis, note on mixture emetic-extract of organs in treatment of, 100
Dropsy and beriberi, problem of epidemic, 149
Dysentery in Mayombe, notes on epidemic of bacillary, 375
——, mixed infection by *Schistosomum mansoni* and *S. hæmatobium* in case of amœbic, 360
Endemic fever accompanied by generalized lymphadenitis, researches, 100
Entamœba dysenteriæ, culture by method of Boeck and Drbohlav, 375
Entamœba from monkey, note on cultivation of, 328
Fuso-spirillary ulcers in Angola, experiments in treatment, 215
—— —— —— ——, note on amœbæ observed in, 216
—— spirochætal affections of skin and mucosæ, anti-spirillar vaccinotherapy in, 344
Glossinæ, contributions to study of geographical distribution of, 36
Glossitis, epidemic observed in Senegal, 360
—— observed in Senegal, communication on nature of epidemic, 376
Goitre, intravenous injections of sodium iodide in treatment of, 276
Hæmaturia, researches in Egypt, 100
Hæmogregarina of horned viper; its forms of reproduction, 344
Hæmorrhoids, treatment by strangulation and snipping method, 392
Helminthiasis, intestinal, in French colonies, 215

CURRENT LITERATURE—*continued.*

Herpetomonas found in gut of sandfly *Phlebotomus argentipes*, fed on kala-azar patients, note 83
—— *muscæ domesticæ*, life history, 84
Hookworm disease, combined carbon tetrachloride and oil of chenopodium in treatment of, 275
—— eggs and larvæ, animals as disseminators of, 19
—— in Palestine, 451
—— infection, notes on some methods for diagnosis, and for estimating egg output, 411
—— larvæ in soil, migration of, 184
—— —— soil acidity and survival, 434
Hymenoptera bethylide which stings man in habitations of the Congo, 36
Indian tick-typhus, 183
Insulin, note on testing in India, 84
Intestinal affections in French Sudan, 136
—— coccidiosis of *Vipera berus* due to *Cyclospora babauli* nov. sp. (Mme. Phisalix), 136
—— intoxication, protozoa in, 235
—— protozoa, culture of, 275
Intra-arterial anæsthesia, excision of pineal body of monkey under, 392
Izal in cholera, 434
Kala-azar in adult of Tunisia, second case, 344
—— —— Algeria, sixth case, 100
——, observations on treatment with urea stibamine in Medical Out-patient Department of Medical College Hospital, Calcutta, 296
—— preliminary note on successful treatment with "Stibamine glucoside," 149
—— relative value of diagnostic methods and evidence of cure in, 20
Leishmanial ulcers, contribution to therapeutic, 216
Leishmaniasis, canine, in Bombay, 84, 327
Leper Island of Culion and anti-leprosy work in Philippine Islands, report on visit to, 312
Leprosy and Wassermann reaction, 344
—— at Martinique, tests of treatment, 151
—— eparseno or Dr. Pomaret's "132" in treatment of, 375
—— in New Caledonia, 150, 235
—— problem in Philippine islands, 452
—— use of kermes in treatment of, 99
Lice, human, apropos pig louse: pig as elective host, 235
Malaria at Oude (Georgia): Study on mountain malaria, 343
—— —— Tangiers during last 20 years, 376
——, concerning efficacy of preventive quinine in prophylaxis of, 136
—— due to *Plasmodium vivax* in native children in Algeria, action of stovarsol in chronic, 476
—— in Abkhasie, parasitology and epidemiology, 296
—— —— Albania, epidemiologic and prophylactic study, 295
—— —— hill-stations in or near Himalayas, notes on, 20
—— —— native children of Algeria, parasitism and morbid reactions in chronic, 376
——, intermittent inflammatory attacks, 100
——, mercurochrome 220 in treatment of, 391
Malaria, quinine plus alkalies in treatment of, 296
——, use of quinine in treatment of, 150
Mosquito repellants, 452
Mycetoma of foot, second Algerian case, 99
Noguchi's fixator for spirochætes used for flagella, 295
Occurrence of spirochæte-like filaments in blood of dengue patients and in normal individuals, 452
Oicomonas granulata in intestine of white mice, 295
Organic arsenic, note on toxic symptoms, 434
Oriental sore at Figuig, existence of, 235
—— ——, clinical observations on multiple, 150
—— —— in Algeria, epidemiological notes, 360
Paranasal tumours of Goundou, anatomic considerations on structure, 136
Parasitic intestinal affection, treatment by tetrachloride of carbon in capsules, 360
Parasitology of Arequipa (Peru) and neighbouring places, 136
Pathology of natives of region of Lokandu, 35
Pemphigus contagiosus, note on cause, 20

CURRENT LITERATURE—*continued.*

Piroplasmoses of sheep in Algeria anaplasmosis, second note on, 100
Piroplasmosis of Bovidæ in government of Petrograd in 1923, 151
——, sheep, in Algeria, third note on, 235
Plague, considerations on epidemiology, 216
—— in Angola, 216
—— manifestations at Dakar, considerations on connection of rodent fauna with, 100
Pneumonia in black race, some observations on, 36
Poliomyelitis, acute, in Belgian Congo, epidemic, 216
Prostate, acute inflammation, 434
Protozoa, intestinal, of man during the epidemics of Petrograd, 235
—— of human intestine, 295
Pseudomyasis at Boma, case of creeping, 35
Pyrexia, abusive use of quinine in treatment of, 136
Rats and rat-fleas in rat burrows, note on efficacy of *neembattis* in destruction of, 328
Recurrent fever, European, details of transmission by lice, 151
Relapsing fever, notes on some cases, 84
Rhabditis larvæ, presence of *Strongyloides stercoralis* (Bavay, 1877), in duodenal liquid taken by tugaba, 375
Santonin, Indian, extracted from Indian species of *Artemisia maritima*, 19
Saussurea lappa—preliminary note on pharmacological action and therapeutic properties of Kuth root, 19
Sleeping sickness in Equatorial French Africa, 99
—— ——, treatment, 295,
Spirochæta bronchialis Castellani, characters, 136
Spirochætes, human intestinal, in Portuguese India, 136
Spirochætosis, human, due to *S. eurygyrata*, experiments on treatment by modern spirillicides, 136
Splenomegaly, Gaucher's type, in a Mahratta village, with case treated by splenectomy, 184
Staphylococcal kidney in childhood, 434
Staphylococcic infections at Tangiers, on frequence of cutaneous, 100
Stibosan (Von Heyden "471"), 434
—— —— —— in private practice, 412
Surgical sundries, 19
Syphilis among blacks of Senegal, 216
——, serum reactions, 149
Trachoma at Tangiers, 136
Trichomonas hominis, is it pathogenic? 275
—— infection in urine, 276
Trypanosoma gambiense, apropos ganglionic substance particularly rich in, 151
Trypanosomiasis and human trypanosomiasis, first experiments with "309" in experimental cases of, 344
——, contribution to study of "309" Fourneau in animal, 360
Tuberculosis, abdominal, in Indian practice, 312
Tumours observed in Cochin China, first results of investigation, 360
Typhoid septicæmia without typhoid ulcers, case of, 150
Typhus-like fever, probably tick-typhus, in Central India, 183
Urine, on technique and significance of Rosindole reaction, applied to, 276
Urticaria, giant, 296
Venereal diseases, prophylaxis, 216
Vincent's angina, on subject of, 295
Viscera, case of complete transposition, 84
Yaws at Costa Rica, 360
—— (frambœsia) in Chin Hills, 312
Yaws, treatment by dermatol, 35

D

Diabetes, insulin in cases of sprue complicated with. Beneficial action of raw pancreas in certain cases of sprue, 230
Diagnosis and treatment, blood- and tissue-changes in cancer with reference to, 297
Diseases of Central America, observations on some, 1
——, some interesting, observed in clinic of Bangkok Central Hospital, 393
Dysentery, amœbic, note on treatment with stovarsol, 378

E

Electric storms in tropics, lightning stroke and, 138
Endemic fevers of Ceylon, some observations on common, 349
Epidemiology of cancer, researches made in Iceland and Italy (July-October, 1924), 39

F

Fish indigenous to British Guiana for control of mosquitoes breeding in vats, tanks, barrels and other water containers, observations on experimental use, 284
Flagellates of anophelines and culicines previously mentioned in literature with description of crithidial form in new host *Anopheles umbrosus* from Federated Malay States, 419
Fresh-water mollusca, contribution to study of radulæ, 365
Funiculitis in Kenya Colony, three cases of Castellani's endemic, 137

G

Gongylonema in Northern Italy, some observations and experiments. A preliminary note, 413
——, some notes on insect intermediate hosts of, 76
—— *subtile* Alessandrini, on identity of, 361

H

Hæmoglobinuric fever, ætiology, 101
—— ——, treatment with caffeine sodio-benzoate, 86
Heterakis neoplastica, Wassink, on identity of, 362
High temperature, influence on preservation of insulin, 103
Hydatigera Lamarck, 1816, cestode genus, species *Reditœnia* Sambon, 1924, 249

I

ILLUSTRATIONS:—
Acladiosis, 394
Adenomata of sweat glands, multiple papillary, 403
Alastrim (2 figures), 6
—— (pustular eruption on forearm), 7
American cockroach, *Periplaneta americana* (*L.*), 62
Amœba from culture of human fæces containing *Iodamœba bütschlii*, camera lucida drawings of successive shapes adopted by single moving, 348
Anaeromyces bronchitica from glucose-agar culture, 259
—— —— —— ten per cent. glycerine peptone water, 259
—— —— glucose-agar culture, 259
Anopheles umbrosus, flagellates, 422
Aphodius hæmorrhoidalis, 415
Arteriosclerotic gangrene, 399
Bacillus vermiculoides Castellani, 218
Bat roost, Mitchell Lake, San Antonio, Texas, 392
Betel-nut carcinoma, 402
Blaps gages L., 46
—— *gibba* cast, 77
—— *mucronata* Latr., 45
—— sp. incerta, larva, 79
Blattella germanica (*L.*), 47
—— ——, larvæ of *Gongylonema* of cattle (4 figures), 417, 418
Blatta orientalis Fol., 56
—— —— nymph., 57
Borrel, Prof. A., 61
British experimental hut at Ostia, June-October, 1900, 38
Burnupia stenochorias, marginal, lateral and central teeth of, 15
Caccobius schreberi, 414
Cancer mortality, alternating, in villages of Pozza and Vigo in valley of Fassa, 51
—— —— in communes of valleys of Fassa and Fiemme (Province of Trento), Italy, 51, 52
—— —— —— —— Fiemme and Fassa (Trentino), 50
—— —— in Iceland, 1911-1920, 41
—— —— —— —— ——, statistics, 42
Cladosporium mansoni, 12
Climatic bubo, 403
Clinical study on malaria in Near-East and in Europe (15 charts), 118-124
Cryptococcus graciloides Castellani, 218
—— *macroglossiæ*, Castellani, 218
Cyst of ovary, 398

ILLUSTRATIONS—*continued.*

Dermatitis cupoliformis, 396
Dientamœba fragilis, single moving at intervals of from fifteen seconds to one minute, camera lucida drawings of successive shapes adopted by, 346
Diseases, some interesting, observed in clinic of Bangkok Central Hospital, cases 1-31, 393 to 405
Ear manicure, 405
Elephantiasis, 397
—— in Hindu girl, case of, 64
Filaria bancrofti, larva in blood of man, 65
—— ——. Two specimens actively migrating through labium of *Culex fatigans*, 65
Fly-prooof latrines for coloured persons (2 figures), 231
Folliculitis decalvans cryptococcica, case of, 220
Frambœsia tropica, 398
Fresh-water mollusca, photographic plate, showing lead models of typical teeth of various, 365
Gongylonema, carcinoma in stomach of rat infested by, 62
——, eggs, 62
—— from mouse, anterior extremity of female, 314
—— —— ——, eggs, 314
—— in situ, transverse section of rat's œsophagus showing, 62
——, larva encysted in muculature of cockroach, 62
—— *neoplasticum*, 61
—— œsophagus of Faenza sheep heavily infested with, 71
—— pulchrum, 66
Granuloma inguinal, 404
—— —— (3 figures), 7
—— venereum (4 figures) 303, 304
Guatemala nodule. Section, 3
—— nodule and "coast erysipelas," 4
—— nodules, 3
Hemispora rugosa, 248
Hodgkin's disease, 399
Hyperpituitarism and hypopituitarism, 397
Isidora from Mauritius, fifty-six rows of identical teeth in, 15
—— *tropica*, marginal, lateral and central teeth of, 15
Keratosis pilaris, 395
Kyphosis, acquired, 400
Leishmaniosis of ear, 8
—— —— face, 8
Leprosy, 397
Lime-casts in kidney (2 figures), 282
Macroglossia blastomycetica, 219
Malassezia tropica, from mycotic yellow patches, 12
Manitol peptone water tube, 427
Map of Iceland showing position of places visited or mentioned, 43
Monilia pinoyi Castellani, 246
—— *tropicalis*, 259
—— ——, glucose-agar culture, 259
—— ——, preparation from a glucose-agar culture, 250
—— —— Castellani, 246
Mossy foot, 10
—— ——. Section stained with Weigert-hæmatoxylin, 10
Mumps, 405
Muspicea borreli, Sambon (2 figures) 69, 70
Myasis, case of severe, due to *Crysomyia macellaria* (2 figures), 5
Onchocerca cæcutiens (2 figures, female and male), 1
—— ——, microfilaria, 2
Oniticellus fulvus, 414
—— ——, photomicrograph of head of *Gongylonema* larva, 417
Onthophagus taurus (2 figures), 414
—— ——, encapsuled *Gongylonema* larva (2 figures), 415, 416
Opisthorchis felineus, 63
Oxyuris tetraptera, 68
Paget's disease of nipple, 403
Pane's "*Filaria labialis*," a *Gongylonema*, probably *G. pulchrum*, 50
Phallic worship, 404
Pinta, 12, 13
——, yellow, 12
Pityriasis nigra, caused by fungus of genus *Cladosporium*—*C. mansoni* Castellani 1905, 394
Plan of Villa Lagarina in valley of Adigo (Trentino), Italy, 59

ILLUSTRATIONS—*continued.*

Ptosis, congenital bilateral, 401
Reditænia borreli Sambon, larval form, 61
—— *tæniæformis* as delineated by Francesco Redi, 61
—— —— Batsch, larval form, 61
Red mite of Central America, 10
—— —— —— —— ——, chicken heavily infested with the, 11
Relapsing fever in Northern Nigeria (5 charts), 333, 335, 337, 338
Rhinoscleroma, 6
Sambon's gauze tubes, suggested by cobwebs, and box in which malaria-infected mosquitoes travelled from Ostia to London in 1900, 39
Sarcoma, melanotic, 402
——, spindle-cell, of jaw, 401
Schistosomiasis japonica, study of intensive antimony-therapy. Patients of cases 1—6, 157, 158, 159, 160
—— —— —— —— —— ——, outline of livers and spleens in Wuchang series of seven cases, 162
—— —— —— —— —— ——, graph showing spleen size, 162
Spirochætes, presence in sputum of tuberculous patients (3 figures), 229
Splenomegaly, tropical febrile, 401
Sporotrichosis, 9
Symbiosis of *Cryptococcus graciloides* and *B vermiculoides*, 222
—— —— yeast-like fungus and bacillus. (From glucose-agar culture), 9
Tenebrio obscurus Fab. Dark meal-beetle, 49
—— —— ——, larva, 79
Tinea labialis, 395
Travelling dentist, 405
Tuberculosis verrucosa cutis, 395
Ulcus tropicum, 404
Vaginal moniliases, further observations on, 246, 247
Vitiligo, 396
Xanthoma tropicum, 396
Yeast-like fungus from case of folliculitis decalvans cryptococcica, 220
—— —— —— macroglossia blastomycetia, 219
—— —— —— pseudo-furunculosis blastomycetica, 218
—— —— isolated from case of furunculosis blastomycetica, 219
Yellow fever in Vera Cruz in 1920-1921, studies (1 chart), 170
—— —— —— —— —— —— ——, transmission with blood of case 2, 171
—— —— —— —— —— —— ——, cases treated with anti-icteroides serum, 176

Immunity, acquired, to malarial inoculation, 428
Insect intermediate hosts of *Gongylonema*, some notes on, 76
Insulin in cases of sprue complicated with diabetes. Beneficial action of raw pancreas in certain cases of sprue, 230
——, influence of high temperature on preservation of, 103
Iodine in beriberi, use of, 102
Intermediate hosts, search for, and study of their radulæ, 14

K

Kenya Colony, three cases of Castellani's endemic funiculitis, 137

L

Latrines, fly-proof, for coloured persons, 231

LEADING ARTICLES:—

Bacillus abortus infections in man, 288
Comparative animal and plant pathology—epidemic plant diseases, 381
Gorgas and yellow fever, 407
Hayling British Mosquito Control Institute, 341
Intestinal flagellates, frequency in temperate climates, 320
Jamaica hookworm commission, 232
Malta fever and infective abortion, 443
Massage by Chinese methods, ancient and modern, 305
Nomenclature in medical zoology, 132
Oriental sore, treatment, 353

LEADING ARTICLES—*continued.*

Veterinary education in India, 289
Vincent D'Antoni Hospital in Honduras, 264
White Australia: is it a possibility? 16, 29, 92, 110, 141, 166, 178, 195, 208, 253
Yaws, treatment, 430

Leptospira group of spirochætes, immunological relationships, 201

M

Malaria, dengue *v.*, 126
—— in Near-East and in Europe, clinical study, 117
—— on yaws, influence of climate and, 85
——, prevention and treatment of, 21
——, prophylaxis in, 207
Malarial inoculation, acquired immunity, 428
Medical News, 20, 36, 151, 168, 276, 328
—— work, conditions, a West African bush station, 128
Moniliases, vaginal, further observations on, 242
Mosquitoes breeding in vats, tanks, barrels and other water containers, observations on experimental use of fish indigenous to British Guiana for control of, 284
Mycotic infections of bronchi, notes on mixed. The mixed monilia + anaeromyces infection, 257

N

Near-East and Europe, clinical study on malaria, 117
Nematode parasites found by Dr. Wassink in rats and mice, some notes on, 316
New bacillus and new yeast-like organisms, notes, with remarks on clinical conditions from which they have been isolated, 217

NEW PREPARATIONS, INVENTIONS, ETC.:—

Bovril Limited, another record year, 152
Dibromin, 328
Night trap for gnats, mosquitoes and tsetse fly, 152
Olgar, 328
Silver nitrate solution capsules, 328
Soloid urine-sugar test case, 152
Storaxol, 328
Sulfoxyl salvarsan, 436

Noguchi treatment, results, of prophylactic measures employed in 1923 yellow fever epidemic in Belize, 26
Non-gonorrhœal urethrites, notes, 250
Northern Nigeria, relapsing fever—a study of 300 cases, 332
Novarsan, notes by nurse on treatment of yaws (frambœsia), 424

O

Observations on pruritus ani and pruritis vulvæ of mycotic origin, further, 329
——, some, and experiments on *Gongylonema* in Northern Italy. A preliminary note, 413

ORIGINAL COMMUNICATIONS:—

Acquired immunity to malarial inoculation, 428
Adeno-carcinoma of the mouse, the modification produced by radium on an emulsion of, and its transformation into a curative vaccine, 438
Ætiology of blackwater fever, 88, 105
—— —— hæmoglobinuric fever, 101
Beneficial action of raw pancreas in certain cases of sprue. Insulin in cases of sprue complicated with diabetes, 230
Blood- and tissue-changes in cancer with reference to diagnosis and treatment, 297
British Indians and bilharzia disease, 193
Cancer problem, 37
Cestode genus *Hydatigera* Lamarck, 1816, species *Reditænia* Sambon, 1924, 249
Clinical study on malaria in Near-East and in Europe, 117
Clonorchis infection of the pancreas, pathology of, 437
Conditions of medical work in West African bush station, 128

ORIGINAL COMMUNICATIONS—*continued.*

Contribution to study of radulæ of fresh-water mollusca, 365
Cysts of *Tricercomonas intestinalis* Wenyon and O'Connor 1917 found in human fæces, 223
Dengue *v.* malaria, 126
Fly-proof latrines for coloured persons, 231
Further observations on pruritus ani and pruritus vulvæ of mycotic origin, 329
—— —— —— vaginal moniliases, 242
Gongylonema, 313
—— collected in Italy during October, 1924, with some observations on the genus, 71
Granuloma venereum, 302
Immunological relationships of leptospira group of spirochætes, 201
Influence of climate and malaria on yaws, 85
—— —— high temperature on preservation of insulin, 103
Lightning stroke and electric storms in the tropics, 138
Note on flagellates of anophelines and culicines previously mentioned in literature with description of crithidial form in new host *Anopheles umbrosus* from Federated Malay States, 419
—— —— treatment of amœbic dysentery with stovarsol, 378
Notes by nurse on treatment of yaws (frambœsia) with novarsan, 424
—— on cultivation of certain amœbæ and flagellates of man, using technique of Boeck and Drbohlav, 345
—— —— mixed mycotic infections of bronchi. Mixed monilia + anaeromyces infection, 257
—— —— non-gonorrhœal urethrites, 250
—— —— three new yeast-like organisms and a new bacillus, with remarks on clinical conditions from which they have been isolated, 217
Observations on Castellani's fermentation phenomenon, 426
—— —— experimental use of fish indigenous to British Guiana for control of mosquitoes breeding in vats, tanks, barrels and other water containers, 284
—— —— some diseases of Central America, 1
On identity of *Gongylonema subtile* Alessandrini, 361
—— —— —— *Heterakis neoplastica*, Wassink, 362
Phosphorus in treatment of various diseases, 377
Presence of spirochætes in sputum of tuberculous patients, 228
Prevention and treatment of malaria, 21
Prophylaxis in malaria, 207
Relapsing fever in Northern Nigeria—study of 300 cases, 332
Report on fatal case of bacillary dysentery in Nigeria, 379
Researches on epidemiology of cancer made in Iceland and Italy (July-October, 1924), 39
Results of Noguchi treatment of prophylactic measures employed in 1923 yellow fever epidemic in Belize, 26
Schistosomum ? spindalis Montgomery in Zululand schoolboy, 406
Search for intermediate hosts and study of their radulæ, 14
Some interesting diseases observed in clinic of Bangkok Central Hospital, 393
—— notes on insect intermediate hosts of *Gongylonema*, 76
—— —— —— nematode parasites found by Dr. Wassink in rats and mice, 316
—— observations and experiments on *Gongylonema* in Northern Italy. A preliminary note, 413
—— —— on common endemic fevers of Ceylon, 349
—— remarks upon *Spirochæta bronchialis* Castellani, and bronchial spirochætosis, 237
Studies of yellow fever epidemic in Salvador, C A., in 1924, 277
—— —— —— in Vera Cruz in 1920-1921, 169
Study of intensive antimony-therapy in schistosomiasis japonica, 153
Three cases of Castellani's endemic funiculitis in Kenya Colony, 137
Treatment of blackwater fever, 225
—— —— cholera and its complications, 261
—— —— hæmoglobinuric fever with caffeine sodio-benzoate, 86
Tropical oto-laryngology with special reference to Philippine Islands, 202

ORIGINAL COMMUNICATIONS—*continued.*

Unemployment and crime, a study of some removable causes of, 441
Use of iodine in beriberi, 102
Yellow fever research, 1918-1924 : a summary, 185

Oto-laryngology, tropical, with special reference to Philippine Islands, 202

P

Philippine Islands, tropical oto-laryngology with special reference to, 202
Preservation of insulin, influence of high temperature, 103
Prophylactic measures employed in 1923 yellow fever epidemic in Belize, results of Noguchi treatment, 26
Pruritus ani and pruritus vulvæ of mycotic origin, further observations, 329

R

Radulæ of fresh-water mollusca, contribution to study of, 365
——, search for intermediate hosts and study of their, 14
Reditænia Sambon, 1924, species, cestode genus *Hydatigera* Lamarck, 1816, 249
Relationships, immunological, of leptospira group of spirochætes, 201

REVIEWS :

Artificial sunlight and its therapeutic uses, 435
Fifty years of medical progress, 435
Leprosy, 436
Mason's tropical diseases, 434
Swanzy's handbook of diseases of eye, 436

S

Salvador, C. A,, studies of yellow fever epidemic in 1924, 277
Schistosomiasis japonica, study of intensive antimony-therapy, 153
Spirochæta bronchialis Castellani, and bronchial spirochætosis, some remarks, 237
Spirochætes, immunological relationships of the leptospira group, 201
—— presence in sputum of tuberculous patients, 228
Sprue, beneficial action of raw pancreas in certain cases. Insulin in cases of sprue complicated with diabetes, 230
Sputum of tuberculous patients, presence of spirochætes, 228
Stovarsol, note of treatment of amœbic dysentery with, 378

T

Treatment of malaria, prevention and, 21
Tricercomonas intestinalis Wenyon and O'Connor 1917, cysts found in human fæces, 223
Tropics, lightning stroke and electric storms, 138
Tuberculous patients, presence of spirochætes in sputum, 228

U

Urethrites, notes on non-gonorrhœal, 250

V

Vaginal moniliases, further observations on, 242
Vera Cruz, studies of yellow fever in 1920-1921, 169

W

West African bush station, conditions of medical work, 128

Y

Yaws (frambœsia), notes by nurse on treatment with novarsan 424
——, influence of climate and malaria on, 85
Yellow fever epidemic in Belize, results of Noguchi treatment of prophylactic measures employed in 1923, 26
—— —— ——, studies in Salvador, C.A., in 1924, 277
—— —— in Vera Cruz in 1920-1921, studies, 169
Yeast-like organisms and a new bacillus, notes on three new, with remarks on clinical conditions from which they have been isolated, 217

LIST OF PLATES.

Clinical study on malaria in the Near-East and in Europe (1 chart, folding plate) 118
Cysts of *Tricercomonas intestinalis* Wenyon and O'Connor 1917, found in human fæces, 223
Dermatosis papulosa nigra, 10
Pathology of *Clonorchis* infection of the pancreas, 437
Pinta, 10
Serum turbidity reaction or blood-test in cancer, Plates I and II, 300

INDEX OF SELECTIONS FROM COLONIAL MEDICAL REPORTS.*

GENERAL INDEX.

(169) Calcutta (*continued*), 1, 5
(170) Trinidad and Tobago, 6, 9
(171) Mauritius, 10, 13, 17
(172) Madras, 17
(173) Ceylon, 21, 25
(174) Bihar and Orissa, 27, 29
(175) Colombo, 30, 33, 37
(176) Seychelles, 40
(177) Sierra Leone, 41, 45, 49
(178) Cairo, 50
(179) Cairo, 51, 53, 57, 61, 65, 69
(180) Bihar and Orissa, 70
(181) Sudan, 71, 73
(182) Bengal, 73
(183) British Guiana, 75, 77
(184) Calcutta, 80. 81, 85, 89
(185) Trinidad and Tobago, 91

* *Note to Binder.*—These are to be bound to follow the last number in the volume of the JOURNAL OF TROPICAL MEDICINE AND HYGIENE.

Original Communications.

OBSERVATIONS ON SOME DISEASES OF CENTRAL AMERICA.[1]

By Aldo Castellani, C.M.G., M.D., F.R.C.P.

During my recent visit to Central America, which I undertook, together with several colleagues, at the invitation of the United Fruit Company of America, I had the opportunity, thanks to the kindness of the Company's officers, to see a very large amount of most interesting clinical material, and in the brief sojourns at the various places we visited I was also given every facility to study certain cases in the magnificent hospitals and laboratories of the Company, as well as in the well-equipped local Government Hospitals of Guatemala, Costa Rica and Panama. There was, of course, no time to carry out any investigation, but I was able to collect a certain amount of material and to make a few observations, which I venture to think may perhaps be of some slight interest, as several of the diseases found in Central America are not well known to us in Europe, though most of them have been thoroughly investigated locally.

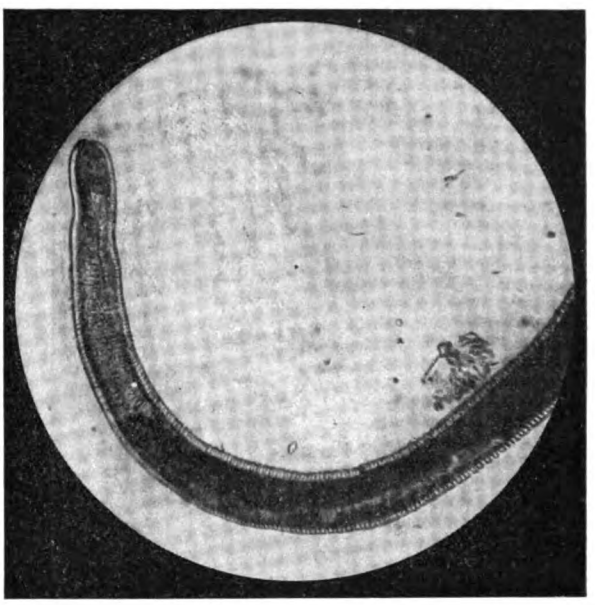
I propose touching briefly on the following subjects:—

(1) Guatemala nodules (Guatemala onchocerciasis).
(2) Central American myasis (el torsalo, gusano).
(3) Tropical rhinoscleroma.
(4) Alastrim.
(5) Dermal leishmaniosis of Central America.
(6) Granuloma inguinale.
(7) Mycotic diseases.
(8) A new type of mycotic stomatitis.
(9) Pineapple estates pyosis.
(10) Dermatosis papulosa nigra.
(11) Mossy foot.
(12) The red mite of Panama.
(13) Pinta.

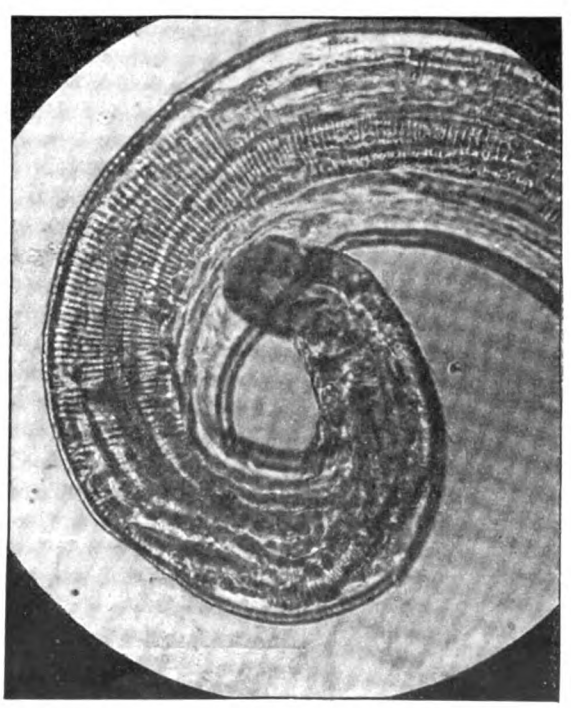
Guatemala Nodules.

(Onchocerciasis of Guatemala).

Historical.—For some years local practitioners, planters, and farmers of certain districts of Guatemala, on the Pacific slopes of the country, had noticed that a large number of the Indian labourers on the coffee plantations presented some peculiar nodules on the scalp. They had also noticed that these carriers of nodules often suffered from eye-trouble, and that another condition was common in the same district, characterized by swelling of the face and fever, usually known locally as "erisipela de la costa." These conditions apparently did not attract the attention of any investigator and nothing was published, even from the mere clinical point of view, until Robles, in 1915, began his researches and elucidated the etiology of the nodules by finding in them adult filariæ of the *Onchocerca volvulus* type and enormous numbers of microfilariæ. Robles came also to the conclusion that the same filaria was the cause of the eye condition so often found in carriers of the nodules, and that it was also the cause of the erysipelatous affection of the face known as "erisipela de la costa"



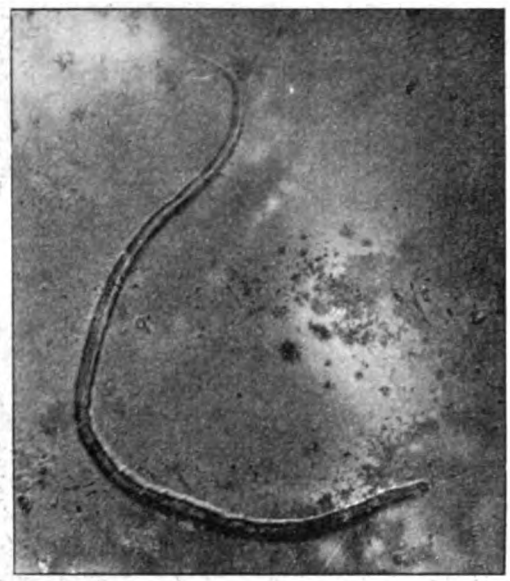
Onchocerca cæcutiens, female. (From Dr. V. M. Calderón.)



Onchocerca cæcutiens, male. (From Dr. V. M. Calderón.)

[1] Amplification of a paper read before the Royal Society of Medicine (Tropical Section), November 13th, 1924.

(erysipelas of the coast). Robles sent some of his material to Brumpt, who confirmed his findings and created a new species for the filaria: *Onchocerca cæcutiens*, Brumpt, 1919, the blinding filaria.



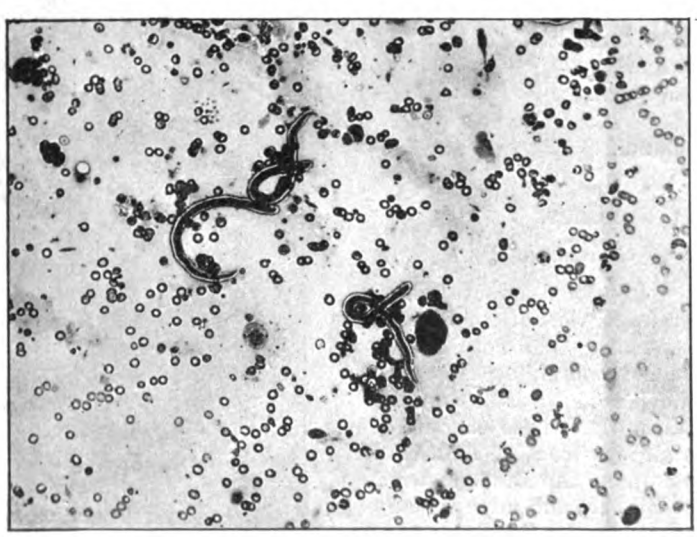
O. cæcutiens, microfilaria.

Robles' work was confirmed and greatly enlarged by Calderón, who carried out a large number of researches on the experimental reproduction of the nodules and the transmission of the filaria, and for this purpose lived for three years on a distant coffee plantation in which the disease was common. The more recent work of Fülleborn is also of great interest. He doubts whether the new species of filaria created by Brumpt is valid, as he sees no morphological differences between *O. cæcutiens* Brumpt, 1919, and *O. volvulus* (Leuckart, 1893); he does not believe that "erisipela de la costa," and the eye condition are in any way connected with the nodules and the filaria.

While in Guatemala, thanks to the kindness of Dr. Calderón, and the Superintendent of the General Hospital of Guatemala city, I had the opportunity of seeing and studying eleven cases of nodules, most of them presenting also eye trouble. Dr. Calderón was good enough to allow me to take some photographs, and also very kindly gave me some of his own photographs and drawings, and some excised nodules. Professor Fülleborn, and Dr. Zupuka too, kindly gave me some material. I was also present at the operation of the removal of the nodules from three cases.

Geographical Distribution.—The geographical distribution of Guatemala nodules is extremely limited. The condition has been found, so far, only in a narrow strip of land on the Pacific Slopes of Guatemala (districts of Sacatepiquez, Escuintla, Chilmaltenango, Solola) at an altitude of 600 to 1,200 metres, and no cases have been reported from any other Central American country. Personally, I am inclined to believe that further investigation will reveal that the condition is not so limited, and is probably present in other Central American countries. Fülleborn states that a Mexican planter has described to him a nodular condition of the scalp which sounds very much like Guatemala nodules, in certain valleys of Southern Mexico, especially in the valley de Custipec, at an altitude between 800 and 1,400 metres.

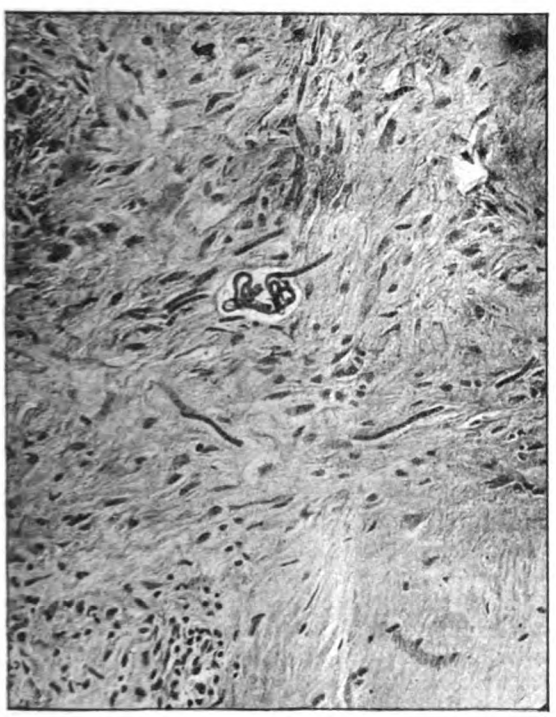
Etiology of Guatemala Nodules.—The examination of the nodules, as found by Robles, shows adult filariæ of the onchocerca type and an enormous number of microfilariæ. The morphological characters of the filariæ and of the microfilariæ are apparently identical with those of *Onchocerca volvulus* (Leuckart) of West Africa; but Brumpt has created a



O. cæcutiens microfilariæ. Film made from the surface of an excised nodule.

new species *O. cæcutiens*, basing it principally on the fact that the two filariæ give rise to two somewhat different clinical pictures: in African onchocerciasis the nodules are more frequently found on the body than on the scalp, while in Guatemala onchocerciasis the nodules are mostly found on the scalp. Moreover, in the African onchocerciasis eye symptoms are rare or absent.

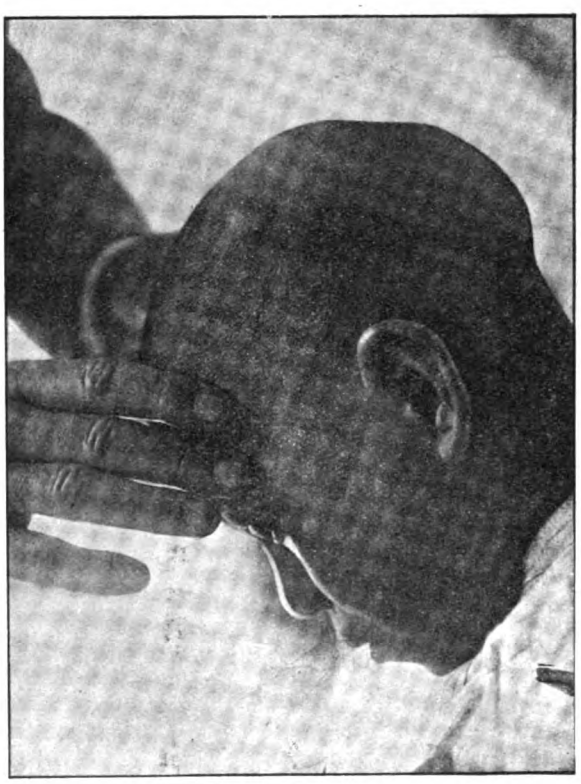
The average dimensions of the *O. cæcutiens* are as follows: male, length 24 to 42 mm., breadth 154 to 190 microns; female, length as much as 50 mm., breadth 300 microns; vulva situated about 800 microns from anterior end. Eggs oval. For further morphological details the reader is referred to the interesting paper of Brumpt in the *Bull. de Path. Exotique*, p. 442, July 9, 1919.



Guatemala nodule. Section stained with hæmatoxylin-eosin. Note microfilariæ.

Clinical Symptoms.—In a well-marked case several nodules, each the size of a pea to a large nut, are seen on the scalp, though less frequently they may be found also on the body, especially on the sides of the chest close to the ribs. The nodules are deeply embedded in the subcutaneous tissues, and the skin over them is often movable, so much so that the first impression may be when they are in proximity of bones that they form part of these. Occasionally the scalp nodules develop under the periosteum, producing concavities in the bones, and in rare cases these may become perforated, and nervous symptoms, such as Jacksonian epilepsy, may make their appearance. The nodules, as a rule, have no tendency to spontaneous cure; very rarely they may become absorbed; in exceptional cases they come to suppuration.

The Eye Symptoms.—A large number of carriers of nodules present severe eye-symptoms which, however, according to Fülleborn and others, are not related in any way to the filarial infection. The eleven cases I saw at Guatemala city, nine of them under the care of Dr. Calderón, all showed in various degrees eye-symptoms which may be briefly described as follows: There is severe photophobia; the palpebral conjunctiva is very hyperæmic; there are often signs of keratitis, so-called keratitis punctata, and later diffuse keratitis. In a number of cases the pupils are somewhat distorted and do not react either to light or accommodation, or only in a very sluggish manner. The fundi are generally normal.

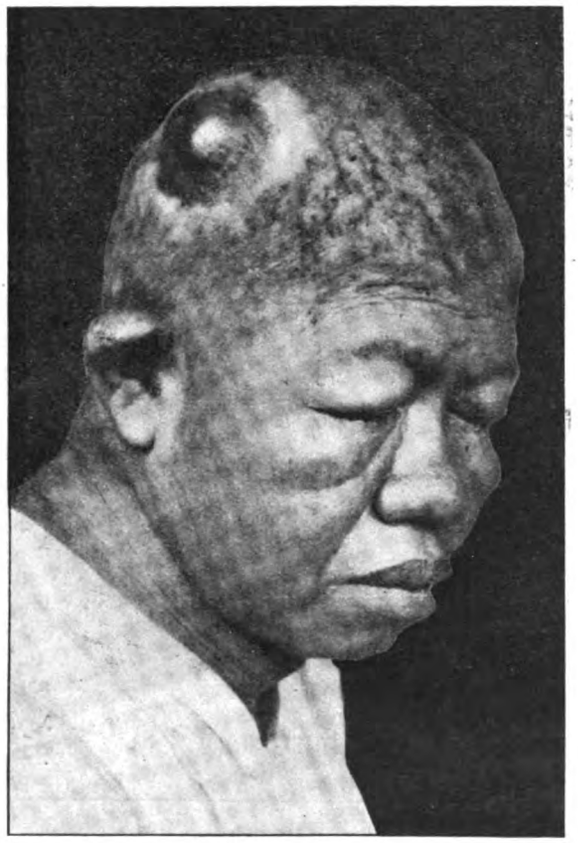


-- Guatemala nodules.

Are the Eye Symptoms connected with the Filarial Infection?—As I have already stated Fülleborn and others maintain that the eye-symptoms observed in so many carriers of nodules have nothing to do with the presence of the filarial nodules; they are observed, they state, in a number of natives who do not suffer from onchocerciasis. In my opinion they are connected with the nodules and the onchocerca. Dr. Calderón showed me a number of histories of cases, from which it was clear that the eye-symptoms as a rule improved very quickly after removal of the nodules, and later on cleared up completely. It is on record that patients who were absolutely blind regained their sight perfectly ten days after the operation. Calderón is inclined to believe that the eye-

symptoms are not caused by any mechanical action of the filaria, but by toxins secreted by it.

Erisipela de la Costa (Erysipelas of the Coast).—In the districts in which the nodules are common a condition is very frequently observed characterized by the following symptoms: The patient, without practically any prodromata, suddenly develops a high temperature without rigors; the temperature very quickly rises and remains high (103-104°) for two or three days, when it rapidly falls to normal with little or no sweating. At the same time that the temperature rises, and while the temperature lasts, the skin



Guatemala nodule and "coast erysipelas."
(From Dr. V. M. Calderón.)

of the face, scalp and ears becomes œdematous and rather hard, and occasionally, especially at the tip of the nose, a peculiar bluish-greenish discoloration is seen; there is no redness as in ordinary erysipelas. The œdema gradually disappears after the temperature has become normal, but the skin on the face, and especially on the forehead, often remains somewhat rough, occasionally slightly thickened, and there may be a very slight pityriasic desquamation.

Is the so-called "Coast Erysipelas" connected with the Nodules? Is it a Manifestation of Onchocerciasis?—Fülleborn and others consider that this condition is not connected with the filarial nodules. Personally, especially after seeing two of Dr. Calderón's patients, who had just recovered from an attack of coastal erysipelas and had nodules on the scalp, I cannot help thinking that coastal erysipelas is a manifestation of the *O. cæcutiens* filariasis. In fact, in my opinion, the nodules, the keratitis, and the coastal erysipelas are manifestations of the same condition—*O. cæcutiens* infection.

Diagnosis.—In the districts in which the condition is endemic the diagnosis is extremely easy. In any doubtful case puncture of the nodules will clear the diagnosis. It may be stated here that, as first observed by Calderón and Fülleborn, microfilariæ are found in the subepidermal tissues of the skin in parts of the body which are situated far from the nodules; they are rarely observed in the blood of the general circulation.

This is perhaps the place to say a few words on Guatemala nodules in relation to African volvulosis. Are the two conditions the same? Are the two filariæ identical? Fülleborn considers the two filariæ identical; Calderón in one of his papers expresses the opinion that onchocerciasis may have been introduced into Guatemala by Jamaican blacks whose ancestors came from West Africa. It is to be noted, however, that the condition is absolutely unknown in Jamaica. Personally, I am inclined to believe that the two conditions, West African onchocerciasis and Guatemala onchocerciasis, although very similar are not identical. As regards the morphological identity or otherwise of *O. cæcutiens* with *O. volvulus* this is a subject to be investigated by helminthological experts. It should be remembered, however, that many parasites which were considered to be identical even a few years ago have now been demonstrated to be different species.

Prognosis.—The nodules, after reaching a certain size become quiescent, and the attacks of coastal erysipelas, too, after some time, seem to cease, but the eye-symptoms become steadily worse, and in a number of cases total blindness ensues.

Transmission of Guatemala Nodules.—Robles suspected at first certain species of *Simulium*. Calderón's recent researches tend to incriminate a *Culex* mosquito.

Treatment.—This is surgical enucleation of the nodules under local anæsthesia. Tartar emetic, salvarsan, neosalvarsan have been given intravenously without any benefit whatever. Fülleborn has tried the intranodular injections of cocaine, but no definite results were achieved.

Prophylaxis.—Very little is known on this subject; if Dr. Calderón's researches are confirmed, anti-mosquito measures will be found useful.

In concluding this section of my paper it is my pleasant duty to express my deep thanks to Dr. Calderón for his kindness in allowing me to examine a number of his patients, and for giving me a large amount of material; my thanks are also due to Professor Fülleborn for much valuable information given me, especially with regard to the morphology of the filaria and the literature on the

Central American Myasis.

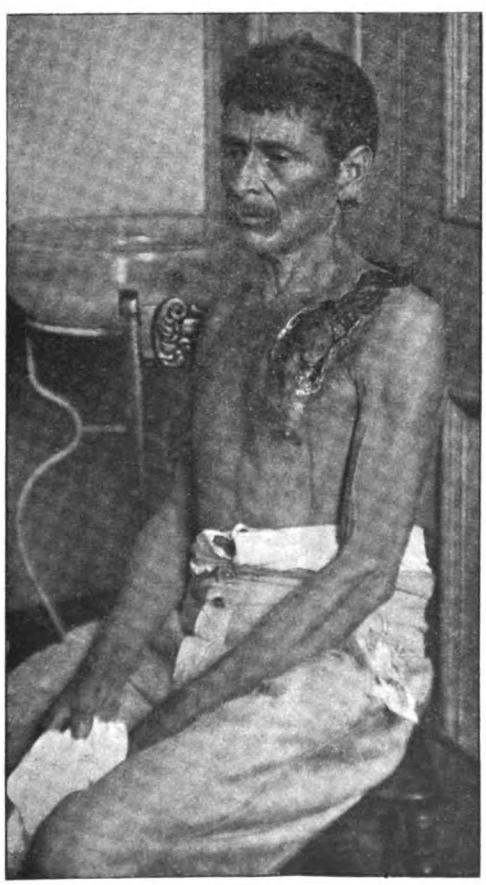
(El Torsalo, Cusano, &c.)

Myasis is extremely common in all Central American countries. Two types must be distinguished :—

(1) *Primary Myasis.*—The fly-larva is the true cause of the condition.

(2) *Secondary Myasis.*—The fly-larva is a secondary invader.

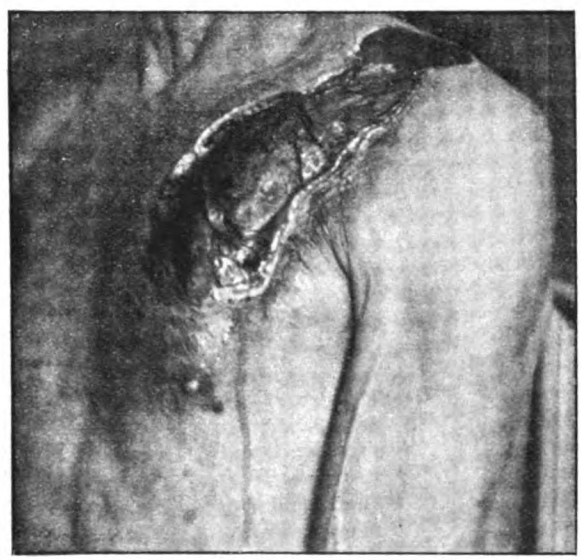
The commonest form of myasis met with is the "furuncular," or "boil-like," type. The condition is very painful, and at first looks like an ordinary large boil; later, at the apex, a small aperture is seen covered by a crust, on removal of which, not rarely, a moving body with two small brownish-yellowish spots (the posterior end of the larva) can be seen. If the condition is left to itself, in due course the larva dilates the opening by means of its posterior end and eventually escapes, and, falling to the ground, crawls away and becomes a pupa.



Case of severe myasis due to *Crysomyia macellaria*. (From Dr. Picado and Dr. Umana.)

As regards the mode of infection there is a consensus of opinion at the present time that the eggs of *Dermatobia hominis* (Linnæus, junior, 1781) better known as *D. cyaniventris* (Macquart, 1843) are carried by the female mosquito of the species *Janthinsoma lutzi* (Theobald). It would appear that the fly seizes the female mosquito and attaches her eggs to the ventral aspect of the abdomen; it has also been suggested that the fly deposits the eggs upon foliage, and these accidentally reach the mosquitoes.

The treatment is surgical; in the first stages opening of the boil and removal of the larva; in the later stages extraction of the larva by means of forceps.



From Dr. Picado and Dr. Umana.

For more details on Central American myasis the reader is referred to the recent monographs and papers on the subject by Umana, Sambon, Arias, Picato and others.

Tropical Rhinoscleroma.

Rhinoscleroma is generally considered to be a disease of Eastern Europe, principally Austria, Poland and Russia. A few cases have been reported from other countries in the temperate zone and in the subtropics. It is extremely rare in the tropics, but there is one exception, Guatemala. For reasons unknown the condition is, comparatively speaking, quite common in that country, and at the General Hospital of Guatemala city I had the opportunity of seeing six cases.

Rhinoscleroma, as is well known, is a disease of the nose which begins insidiously with the formation of a painless pink or red nodule in the anterior nares or on the surface of the nose, or on the adjacent part of the upper lip. The characteristic feature of the nodule or nodules is the peculiar cartilaginous or stony hardness. The nodules after a time may coalesce into a large mass, which often completely blocks up the anterior nares. The surface of the mass is smooth and tense, and tends to crack. The tumour has a tendency to recur after removal. The disease is believed to be caused by the bacillus of Frish, which is a bacillus closely allied to Friedländer's pneumobacillus. With regard to the cases I saw in Guatemala city, in three of them an ulcerative pro-

cess, clinically resembling leishmaniosis, was present, and in one verrucoid lesions were seen which clinically looked very much like blastomycosis. These ulcerative processes, however, were apparently secondary, and had developed on true rhinoscleroma, as certain portions of the masses were extremely hard, like bone, and such hardness is not a feature of simple blastomycosis or leishmaniosis. Unfortunately, there was no time to investigate the cases, and two slides I took from one of them were mislaid. The routine treatment of rhinoscleroma at the Guatemala City Hospital is by X-rays.



Rhinoscleroma (case seen at the General Hospital, Guatemala City).

ALASTRIM.

In Jamaica we saw a large number of cases of alastrim, and among the various colleagues who saw them the usual discussion took place. Is alastrim a synonym for smallpox, or is it a different disease? The majority, including myself, was inclined to come to the conclusion that alastrim and smallpox are due to two slightly different viruses. The eruptive elements can hardly be distinguished, but in practically all the cases we saw, even in those with a most abundant eruption, the general condition of the patient was remarkably good, and we were told that secondary fever is generally absent. The scarring and pitting in convalescents was much less marked than in convalescents of typical smallpox. The mortality, in contrast to the high mortality of smallpox, was less than 1 per cent. It is known also that Jenner's vaccination may be successfully carried out shortly

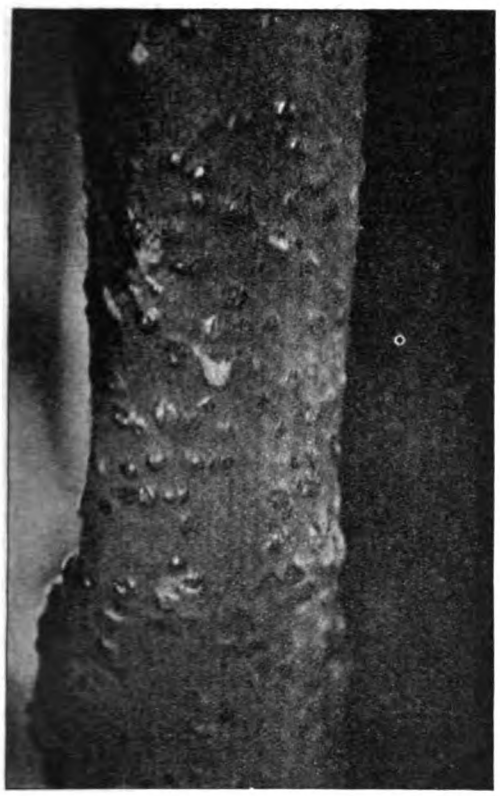


Alastrim (Jamaican case).

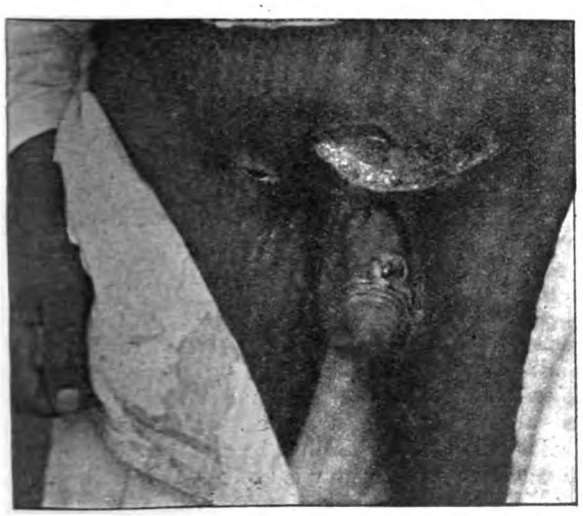


Alastrim (Jamaican case).

after an attack of alastrim. Remembering how many varieties of relapsing fevers there are, it seems to me hardly surprising that there should be at least two varieties of smallpox.



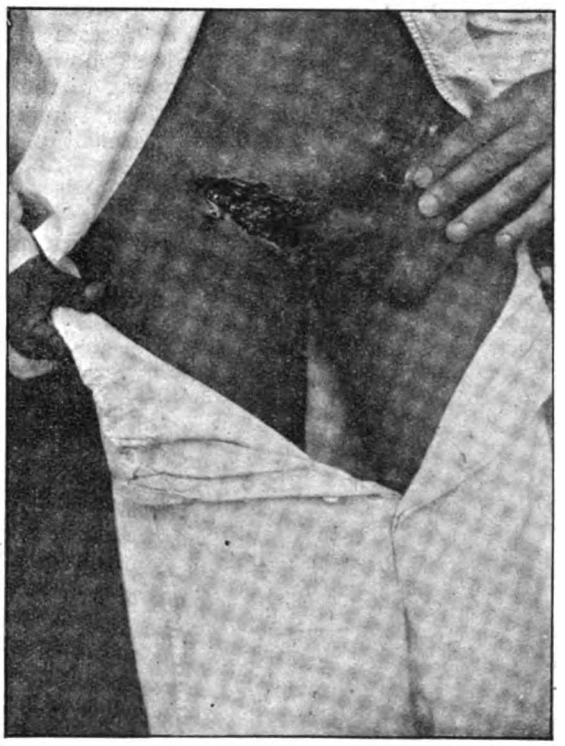
Alastrim (pustular eruption on the forearm).



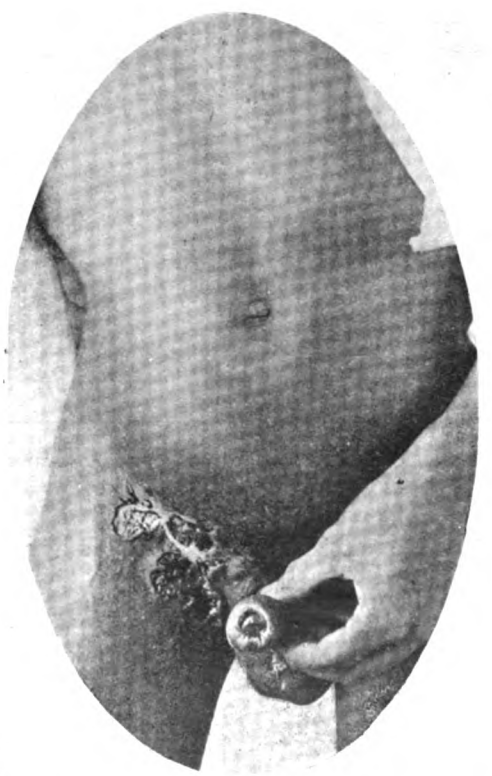
Granuloma inguinale.

Granuloma Inguinale.

This condition is common all over Central America, especially in coloured people. Bass and Jhons have found it also much further north, in the States, in



Granuloma inguinale.



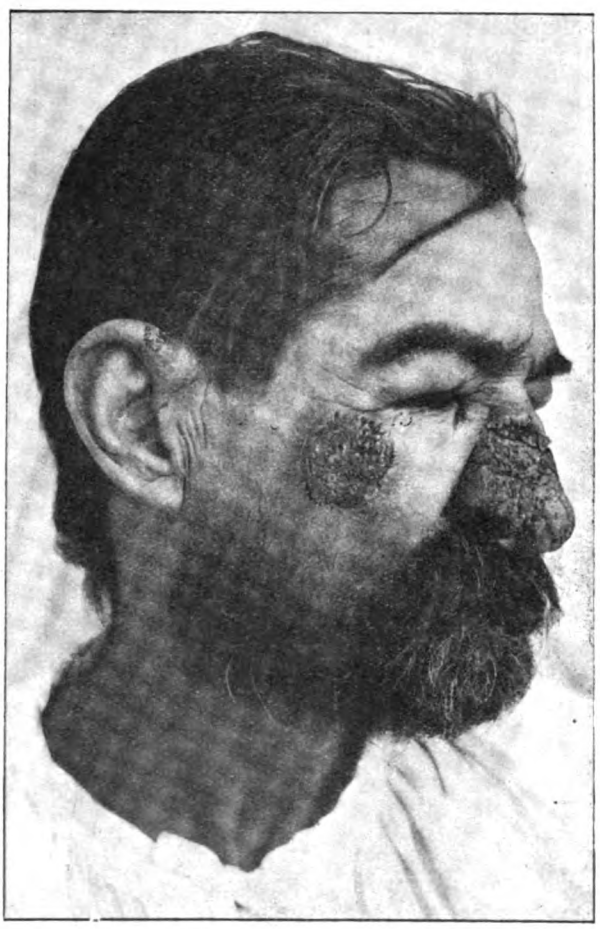
Granuloma inguinale. (Courtesy of Dr. Perez Anleu.)

Louisiana. Some beautiful cases were shown to us in the Porto Castillas Hospital. In most cases scrapings from the ulcers made by Dr. Jhons showed the presence of Donovan bodies. According to the experience of medical men practising in Central America, tarter emetic answers well in the treatment of this disease.

Dermal Leishmaniosis.

Three types of dermal leishmaniosis are seen in Central America in my experience.

(1) The espundia type, affecting the nose, palate and throat.



Leishmaniosis of the face (Courtesy of Dr. Ovares.)

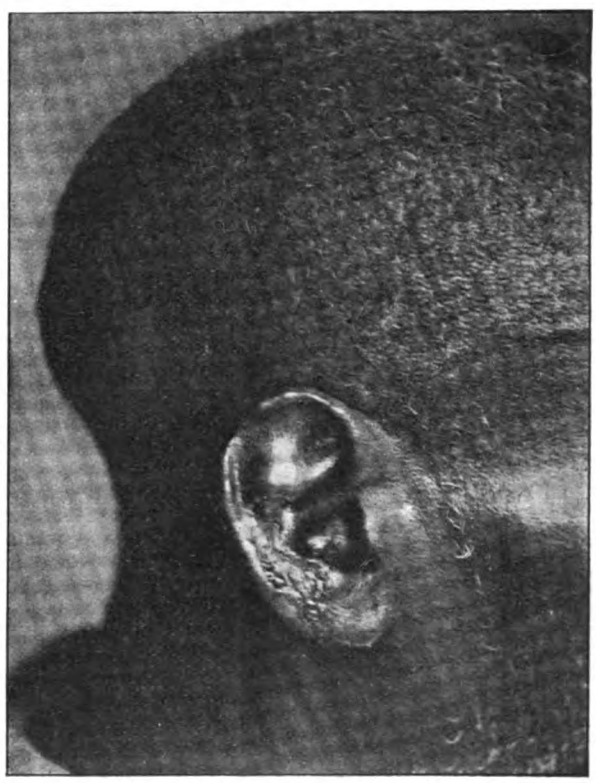
(2) The frambœsial type, characterized by the presence of large nodules somewhat resembling yaws. These nodules occasionally may resemble blastomycosis. A sub-variety of this is leishmaniosis of the lobe of the ear in which the nodule ulcerates quickly and the result is a large loss of substance.

(3) The oriental sore type. This is, clinically, absolutely identical with the conditions so common in certain parts of Asia and Africa, and which goes by the name of "Aleppo boil," "Delhi boil," "Biskra boil," &c.

It is interesting to note that Noguchi has found in Brazil that serologically the leishmania isolated from espundia cases is different from the leishmania isolated from oriental sore cases. The tartar emetic treatment answers apparently better in the espundia and yaws types than in the oriental sore type.

A New Type of Mycotic Stomatitis.

In Honduras I saw two cases of a peculiar mycotic stomatitis, quite different clinically from ordinary thrush. The patches, which were of large dimensions, situated on the oral mucosa and tongue, were much less raised than in thrush and not so creamy-white: they looked much more like a thin, translucid, whitish film covering parts of the mucosa. The

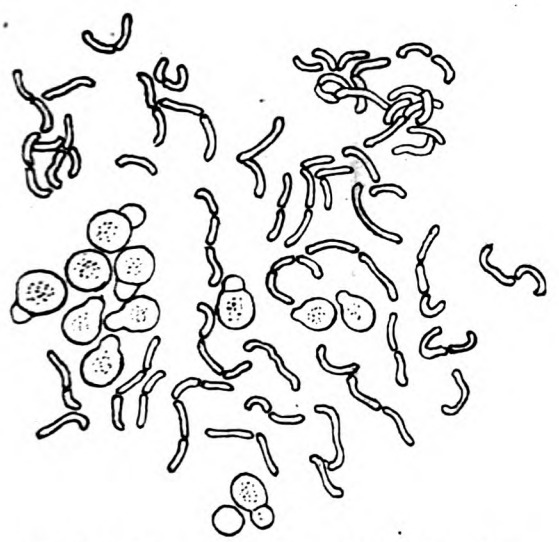


Leishmaniosis of the ear.

first impression was that they were patches of incipient, diffuse leukoplakia of the smooth type. Definite ulcerative lesions were not present. I was able to make some scrapings and immediately inoculated a few glucose-agar tubes. The result of the mycological investigation has been rather interesting; the condition is probably caused by a bacillus and a rather delicate yeast-like fungus which apparently live in symbiosis. Until very recently I did not succeed in separating the two by plating or other devices. By using certain media I have now separated the two organisms, but I have not yet completed the biochemical investigation of them. In contrast to the fungi-producing ordinary thrush the colonies of this fungus and bacillus are extremely

minute and delicate. The reactions of the associated organisms in sugar media are as follows :—

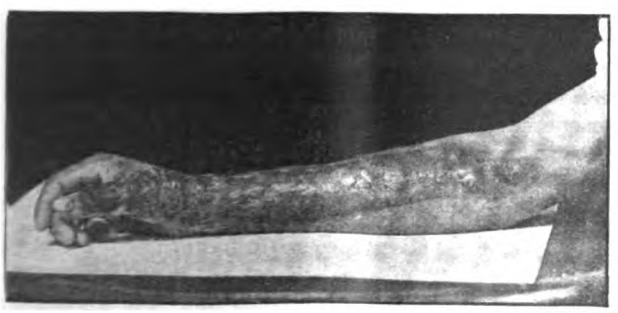
	3 day	7 day
Lactose	A	A
Saccharose	O	O
Dulcite	O	O
Mannite	O	O
Glucose	A	AG
Maltose	A	A
Dextrin	O	O
Raffinose	A	A
Arabinose	O	O
Adonite	O	O
Inulin	O	O
Sorbite	O or A	
Galactose	A	A
Levulose	AG	AG
Inosite	O	O
Salicin	O	O
Amygdalin	O	O
Isodulcite	O	O
Erythrite	O	O
Glycerine	O	O
Litmus Milk	A & Clot	
Gelatine	O	O
Serum	O	O



Symbiosis of yeast-like fungus and bacillus. (From glucose agar culture.)

Mycoses.

Internal mycoses, as well as external mycoses, seem to be quite common in all Central American countries. Cases of Bronchomycosis have been placed on record by Picato and others, Cutaneous Blastomycosis and Sporotrichosis are not rare. Picato has described a peculiar tinea-like affection of the scalp due to a Penicillium. From a case of peculiar ulcerative condition I grew a fungus which I have not yet completely investigated. Ringworm infections of the body are common. I saw several cases of Trichomycosis axillaris flava and rubra, but none of trichomycosis nigra.



Sporotrichosis. (Courtesy of Dr. C. Picado.)

Pineapple Estate Pyosis.

In the lower districts of Costa Rica, in the pineapple plantations, a large number of labourers suffer from a type of pyosis, affecting principally the hands and arms, feet and legs. Numerous flattened pustules are seen, some of which break, and small, shallow ulcerations are formed. The hands and arms may be somewhat œdematous. There is little or no itching and usually no fever. The condition heals under a simple antiseptic treatment within ten or twelve days.

As regards the ætiology, the usual pyogenic cocci are found in the pustules and ulcerated lesions ; it is not scabies, as there are no furrows, and the *Sarcoptes* has never been found. It does not seem to be primarily caused by some other mite, as is the case for instance with copra-itch, as pruritus is absent or only slight, but this point might be further investigated.

Dermatosis Papulosa Nigra.

In Jamaica and Central America I have cmoe across a peculiar dermatosis which does not seem to have been described previously. It is particularly common in natives of Jamaica. In a well-marked case a large number of black or very dark-brownish papules, somewhat cupoliform or flattened, are seen on the face, principally on both malar regions, while they are rare or absent on the lower parts of the face and chin : a few may be present on the forehead. They are not pruriginous and not painful. The maximum diameter of each papule varies between 1 mm. and 4 or 5 mm. At times two or three papules are very close together and seem to coalesce. The first papules appear in youth. I have seen them present in small numbers in boys and girls of 16 to 18 years of age. The condition gradually becomes more marked, and the papules increase in number and size the older the patient becomes, and it is quite common to see middle-aged men and women with their faces studded with these black papules.

Histology.—The structure can be best seen in sections stained by Weigert's iron hæmatoxylin and van Geison where the corium or true skin is stained pink and the epithelial layers yellow. The histological description will be given in a future paper, which I am writing jointly with Dr. Mackenzie Douglas.

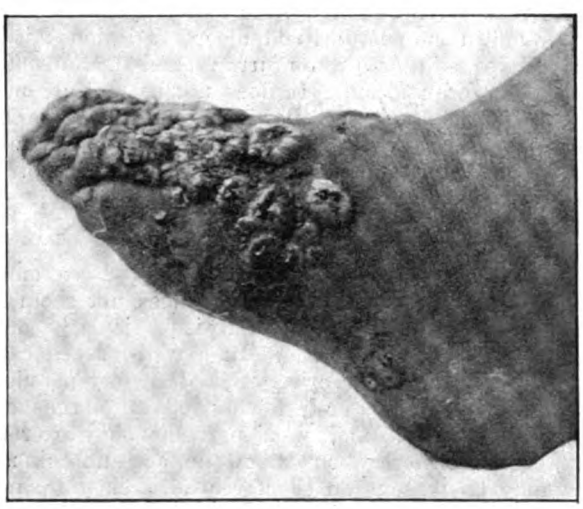
Diagnosis and Ætiology.—The papules are not ordinary warts nor senile warts, lacking the verrucose surface of the former and the greasy appearance of the latter. The ætiology is unknown.

Treatment.—This is very unsatisfactory. The papules may be destroyed by using the micro-burner,

or a strong solution of formalin, but small white marks as a rule remain permanently, and to this the coloured people object more than to the black papules.

Central American Mossy Foot.

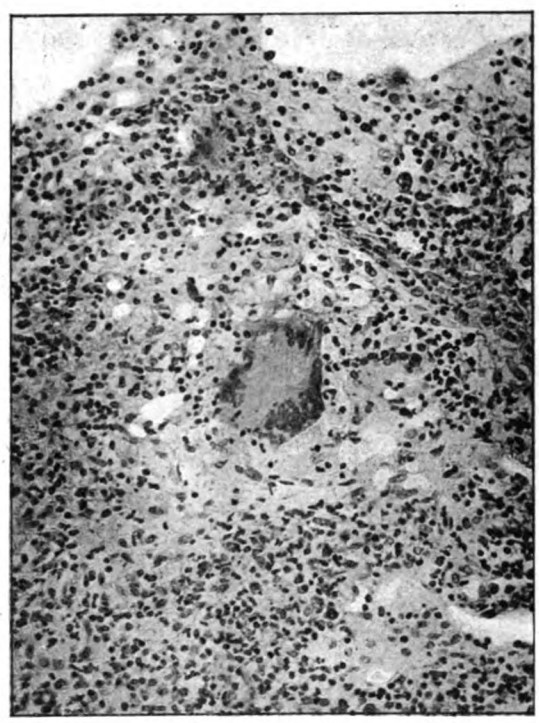
In Costa Rica and Guatemala several medical men informed me that there exists there a peculiar granulomatous condition of the foot, which was considered by some to be a type of madura foot, by others a malady *sui generis*. At Port Lemon I had the opportunity of seeing a case; parts of the dorsum of the foot and toes were covered with granulomatous nodules and masses covered by yellowish dirty crusts. Removing these, the nodules looked very much like yaws nodules but more diffuse, with a granulomatous or papillomatous red surface, exuding a thin secretion, which later on thickens into a crust. Wassermann was negative. I identified the case with the "mossy foot" described in Brazil by Thomas. The condition must be distinguished principally from madura foot,



Mossy foot.

yaws and verruga peruviana. In madura foot there are sinuses discharging a purulent secretion containing sclerotia; both sinuses and sclerotia are absent in mossy foot. In contrast to yaws, the condition is found only on the foot and occasionally the legs, but on no other part of the body, and moreover Wassermann is negative. With regard to the ætiology, nothing definite is known. The treatment is most unsatisfactory; tartar emetic, salvarsan and neosalvarsan having no effect whatever, the administration of potassium iodide and mercury is also ineffective. I suggested that X-rays might be tried.

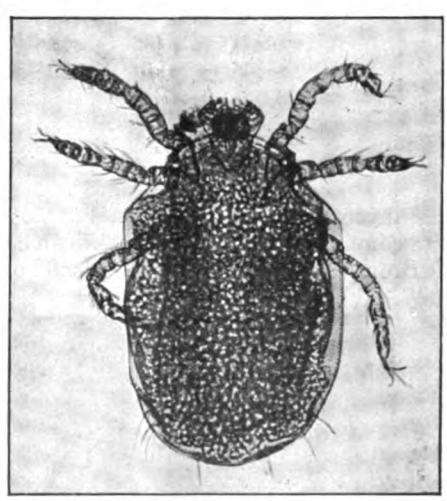
Histology.—Dr. Mackenzie Douglas has noted that the corium is œdematous at places, at other places there is infiltration with lymphocytes and epithelioid cells, closely resembling the appearance seen in granuloma. Here and there giant cells are seen surrounded by epithelioid cells and small round cells, as seen in typical tubercular follicles. No *Bacillus tuberculosis* could be found, however, in sections stained by Ziehl-Neelson.



Mossy foot. Section stained with Weigert-hæmatoxylin. Note giant cell.

The Red Mite of Central America.

All over Tropical America, and principally in certain countries of Central America, Honduras and Panama, red mites are extremely common which attack man,



The "red mite" of Central America (*Trombicula tlalzahuatl*).

small mammals and birds. They are known by various names: in Mexico the red mite found there



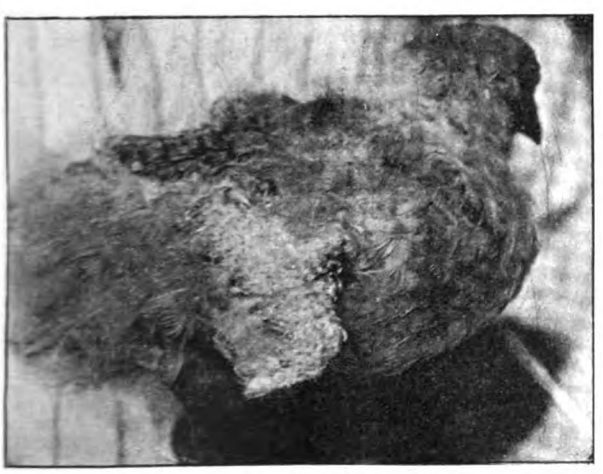
DERMATOSIS PAPULOSA NIGRA.



PINTA.

is called *tlalzahuatl*, in Guiana a similar mite is called the *Balata* or *pou d'agoute ;* in New Granada there is the *naibi;* in Cuba the *colorado ;* in Martinique the *bête rouge*. In Argentine and Uruguay the *Tetranychus molestessimus* (Weyenberg, 1886) is a great pest ; it differs zoologically from the above-mentioned mites, belonging to the family *Tetranychidæ ;* it lives in a web on the interior surface of the leaves of *Xanthum macrocarpum* and attacks man and animals from December to February. Very little is really known of these various mites, and the whole subject in my humble opinion requires revision. I will limit myself to saying a few words on the red mite of Panama and Honduras. While there recently I collected a number of specimens of the red mite and sent them to Dr. Hirst for identification. He has kindly informed me that the mite is *Trombicula tlalzahuatl* figured under the name *Leptus* (Trombicula?) *similis* in his " Mites Injurious to Domestic Animals."

Climatology.—In Central America the red mite is met with principally in the low country, especially



Chicken heavily infested with the red mite of Central America (*Trombicula tlalzahuatl*).

the districts near the coast, but it may be found also, though apparently not in such large numbers, in the hills at a fairly high altitude.

Red Mite Dermatitis.—The mites give rise to an extremely itchy, papuloid eruption, the papules being red and at first rather scattered. True pomphi are not present. In a later stage, owing to scratching and a secondary invasion of staphylococci, a form of pyosis or impetigo may develop.

Experimental Reproduction of the Dermatitis.—If a red mite is picked up, using a toothpick or similar device, and placed on the forearm of the volunteer it will be seen that the little creature moves quickly here and there, and then stops and begins burying itself partially into the skin, and then the patient begins to experience a very severe local pruritus. It is said that the mite buries itself completely into the skin, but this is not so in my experience; the burying is apparently only partial and, after a time, the mite drops off and a papule appears at the place where the mite was.

Lower Animals.—The red mite, in addition to man, attacks many other mammals, dogs, cats, rabbits, &c., but it apparently shows a predilection for fowls and chickens. At Almarantes I have seen a number of chickens with portions of their bodies covered with red specks (the mites) and showing signs of severe sickness with loss of feathers where the mites were more abundant. Numbers of young chicks are actually killed by these pests.

Treatment.—The usual treatment in Central America is sulphur ointment and tincture iodine. What I found most useful to allay the pruritus were carbolic and menthol lotions, especially my old prickly heat lotion which consists of :—

Ac. salicy.	...	...	...	gr. ij.
Menthol	...	...	...	gr. x.
Spir. rect.	...	...	...	ʒij.
Glycerin	...	...	...	ɱxxx.
Zci. ox.	...	...	...	ʒiij.
Calam.	...	...	...	ʒiij.
Aq. rosæ ad	...	...	...	ʒvj.

Prevention.—This consists in wearing high boots, but at times this is not sufficient. It is interesting to see how at Almarantes and other places in Central America even after a short walk in the grass the boots get covered with red mites, some of which go upwards and get inside from the top. Sulphur powder is considered to be a preventive.

Pinta (Carate).

In Honduras I had the opportunity of seeing a number of cases of pinta, more than a dozen, the diagnosis of pinta being confirmed by Dr. Urubuate, of Colombia, an expert on the malady. Two cases of pinta of Mexican origin I saw in Panama, thanks to the kindness of Dr. Connor and Dr. Bates.

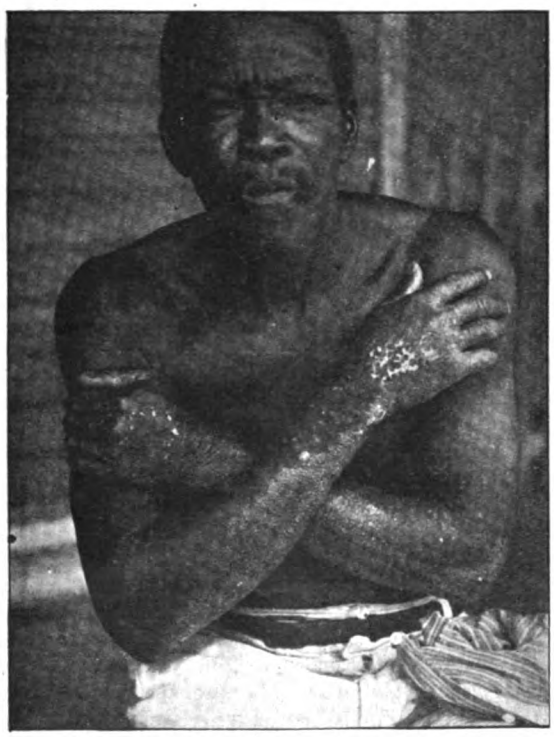
Pinta is generally defined as being a dermatosis characterized by the presence of patches of various colours, jet black, bronzine black, violet, red, yellow, and white, and since the investigations of Ruiz Y. Sandoval and of Montoya the disease has been considered to be of mycotic origin. Ruiz Y. Sandoval believed that there was only one species of fungus and that the different colours of the patches were due to the different depths at which the fungus was growing. Montoya found a very large number of different fungi belonging to the genera *Aspergillus* (*Aspergillus pictor*, &c.), *Penicillium* (*Penicillium montoyai*, &c.), *Monilia* (*Monilia montoyai*, &c.), and also fungi with intermediate characters between these genera. According to him the black, blue and violet patches are caused principally by *Aspergillus* fungi ; the yellow variety by *Monilia* and *Aspergillus ;* the white variety by *Monilia*.

During my brief sojourns at Porto Castilla and at Panama, I examined several cases for the presence of fungi by microscopical and cultivation methods. I may quote the results obtained in four cases.

Case I.—Negro boy about 14 years of age, examined at Porto Castilla, Honduras, shown to

me as a typical case of pinta, diagnosis confirmed by Dr. Urubuate, of Colombia. On the face he had yellow patches which I suspected immediately to be tinea flava; on the chest were several other yellow patches, but with a somewhat different clinical appearance, smoother, with margins not so well defined. On the arms were yellow patches identical with those found on the chest; on the forearms black patches and white patches, not raised, smooth, and looking to me like patches of simple hyperpigmentation (bronzine chloasma-like) and depigmentation (leukoderma); on the dorsum of the hands, white leukodermic-like patches.

Microscopical Investigation. 1. *Yellow Patches on Face.*—A fungus was present in large amount with the characteristics of the fungus of tinea flava (*Malassezia tropica*): Numerous roundish spores, collected in clusters and some mycelial articles; did not grow on glucose agar. I have no doubt that



Pinta. (Case seen at Porto Castilla.)

these patches were patches of tinea flava. For the description of tinea flava and its fungus the reader is referred to the "Manual of Tropical Medicine" (Castellani and Chalmers), p. 2073.

2. *Yellow Patches on Chest and Arms.*—A very few yeast-like bodies of large dimensions present, no mycelial elements. A mould-like fungus was grown which I have not yet botanically determined.

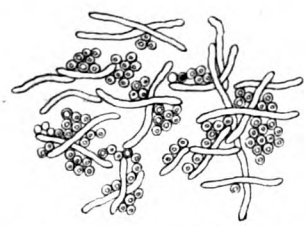
3. *Black and White Patches on Forearms.* Microscopically a few large yeast-like bodies, morphologically identical with those found on the surface of the yellow patches on the chest. The mould-like fungus grown seems to be identical with that grown from the yellow patches on the chest, and those found on the black and white patches.

4. *Normal Skin.* Some large yeast-like bodies present; a mould-like fungus apparently identical with that obtained from the yellow patches on the chest and the black and white patches on the forearms was grown.

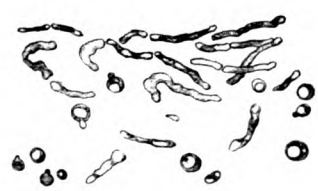


Yellow pinta.

CASE II.—Negro, of about 40 years of age. On the forehead and alæ nasi hyperpigmented patches, some bronzine, others presenting a blue tinge (blue



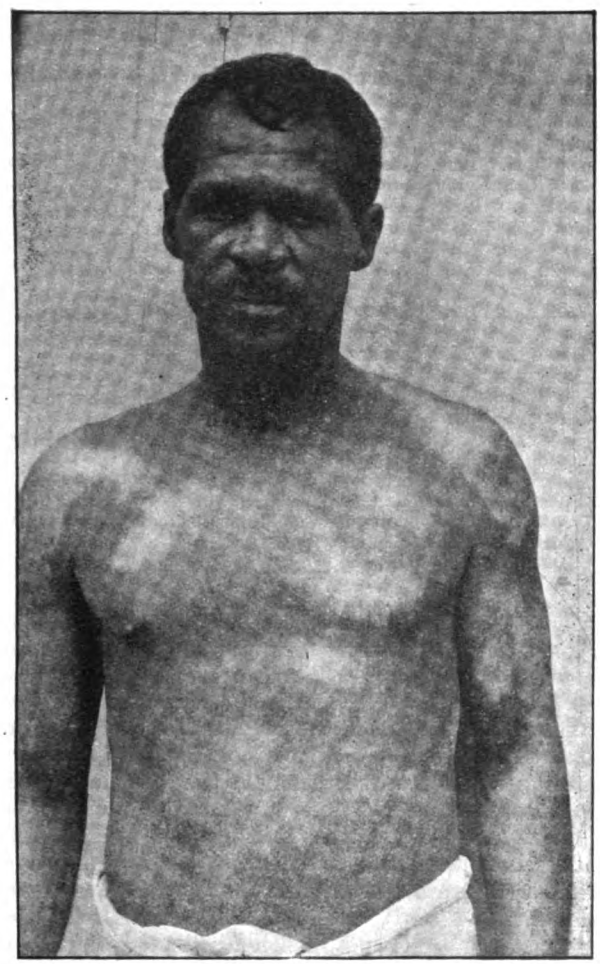
Malassezia tropica, from mycotic yellow patches.



Cladosporium mansoni.

pinta); on the malar region, yellow patches, smooth, with no definite margins; on the upper regions of the arms, diffuse yellow patches; on the forearms, greatly hyperpigmented patches (black); on wrists and hands, patches of depigmentation (white) surrounded by patches of hyperpigmentation. Dr. Banting very kindly made for me sketches of this case.

Microscopical and Cultural Investigation. Scrapings from the bronzine bluish patches on the face and alæ nasi revealed the presence of a few large yeast-like bodies. Identical bodies were found in the yellow patches on the chest and in the black and white patches on the arms and hands. From various patches, and also from portions of the skin which seemed normal, the same fungus, which I have not yet identified, was grown. I am not inclined to give any etiological importance to this fungus as its situation was very superficial; moreover, after washing the skin with soap and water and then applying



Pinta. (Courtesy of Dr. Urubuate.)

alcohol no fungus was detected microscopically, or grown. Scrapings from the yellow patches on the arms contained masses of spores and mycelial elements with all the characters of *Malassezia tropica*. I have no doubt that these were patches of tinea flava.

CASE III.—Negro of about 50 years of age; patches of hyperpigmentation bronzine chloasma-like on the face; on the neck a small black patch slightly raised; on the forearms and hands several leucodermic patches. On the legs and thighs several clinically trichophytic patches with marked hyperpigmentation of the skin. Before making any scrapings all the patches were washed with soap and water and then alcohol. In none of the hyperpigmented patches on the face and apigmented zones on the forearms were fungi seen microscopically, or grown. From the slightly raised patch on the neck, clinically quite different from the bronzine chloasma-like patches on the face, a fungus was found to be abundantly present with the characteristics of *Cladosporium mansoni*. Scrapings from the patches on the legs showed presence of a trichophyton-like organism which I did not succeed in cultivating.

CASE IV.—*Case of Pinta of Mexican Origin.* Patches of different colours, bronzine-black, yellow, and white, all over the body. On the neck, and upper region of the chest typical ringworm lesions. Scrapings in liq. potassæ, from the various pinta patches revealed absence of fungi. It must be noted that scrapings of the epidermis, even of normal individuals, on which liquor potassæ has been acting for a fairly long time often show a large number of oval or roundish formations which might be mistaken for spores of fungi. In any doubtful case staining the preparation will clear the diagnosis. Cultivation showed presence of at least three different species of moulds. These three species were grown from every patch and also from portions of skin which seemed normal. Scrapings from the ringworm patches showed microscopically presence of a typical trichophyton.

Controls. Scrapings from three apparently healthy natives at Porto Castillas were examined microscopically and by culture methods. In two, microscopically, a few yeast-like bodies were found, identical morphologically with those observed in the cases of pinta. Culturally several moulds were grown which also seemed to be identical with those found in pinta. In the third case, no fungus of any kind was present, either microscopically or culturally; only the usual cocci and *B. subtilis* were grown.

Discussion and Conclusions. My investigation of pinta, for lack of time, has been only a preliminary one, and therefore I do not desire to come to any definite conclusions, but I might tentatively state my impressions of the disease *as seen in Honduras*, as follows:—

1. *Yellow Pinta.* This covers at least two conditions. In one, a fungus with all the characteristics of *Malassezia tropica* is found in great abundance; in the other, either no fungus of any kind is found, or, at times microscopically, a few large yeast-like bodies (probably spores of saprophytic fungi), as seen also at times in the black and white patches, and also on the skin of some healthy natives. The first condition is in reality *tinea flava* (Castellani and Chalmers' "Manual of Tropical Medicine," p. 2073), the second might be called yellow pinta *sensu stricto*. In most cases one can make the diagnosis on clinical grounds; the mycotic yellow patches (tinea flava) are generally more sharply limited and may be slightly raised; the non-mycotic patches are not raised and the borders are not usually so sharply defined. It is, in my opinion, probably a process of partial depigmentation, of trophic origin,

a stage in the process of depigmentation from black to white, as in certain cases one can see all the stages from black, yellow, light-yellow, white leucodermic-like.

2. *Black Pinta, including the Bronzine and the Blue Varieties.* Under this heading, too, it would appear that several conditions should be differentiated: (a) Patches of black or bronzine hyperpigmentation with occasionally a bluish tinge, not raised, not pruriginous; no fungi are found microscopically, or only a few spore-like bodies on the surface of the epidermis; cultivation methods may show absence of fungi, or presence of Penicillium-like, Aspergillus-like and other moulds identical with those which one finds at times on the skin of normal natives. The etiological rôle of these moulds, so many species of which have been described by various observers, seems to me to be doubtful and as regards the cases seen in Honduras by me they were in all probability only saprophytes. These patches of hyper-pigmentation appear to me to be very similar, or identical with the various chloasmata (bronzine chloasma, &c.) observed in natives and Europeans all over the Tropics and which are not of mycotic origin. (b) Patches of hyperpigmentation associated with or following on infections with fungi of the group Trichophytoneæ (Atrichophypons, Epidermophytons, &c.) Some years ago I made the observation in Ceylon that chronic infections due to fungi of this group had in some cases a disturbing action on the pigmentation processes of the skin, which became either hyperpigmented or less pigmented, or apigmented, and these patches of hyperpigmentation and hypopigmentation remained visible for years after the fungus had disappeared. These patches in negroes are quite common in the inguino-crural region, also on the back and chest. (c) Black patches caused by the presence in large numbers of *Cladosporium mansoni* (tinea nigra).

3. *White Pinta.* Two conditions may be distinguished. (a) Leucodermic patches, being the last stage in the process of depigmentation, which is represented first by the amycotic yellow patches, and which apparently is not caused by any fungus. (b) Depigmentation patches associated with or following on chronic mycotic infections such as infections with the trichophytoneæ and malassezia fungi.

In conclusion I should like to express my deep thanks to the Authorities of the United Fruit Company for their kind invitation to visit their stations in Central America, and especially should I like to offer my grateful thanks to Dr. E. Deeks, their medical manager. I should also like to express my obligation to all the medical officers connected with the United Fruit Company's hospitals as well as to the doctors of the local Government hospitals for their unfailing courtesy and for their generosity in placing at my disposal a large amount of clinical material.

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"A SEARCH FOR INTERMEDIATE HOSTS AND A STUDY OF THEIR RADULÆ."

By F. G. CAWSTON, M.D.Cantab.

ALTHOUGH, in the hotter months of the year in South Africa, it is possible to collect large numbers of fluke-infested examples of the various intermediate hosts, those that are found in the winter months and the following rainy season are remarkably free from cercariæ. In July I examined a large number of examples of *Burnupia gordonensis* from Grahamstown, C.P., and found them all free from cercariæ. The following month I collected numerous examples of *Burnupia*, as well as at least nine other species of fresh-water snail from Avoca, Natal. No cercariæ could be found in *Burnupia*, and even the *Physopses* were free from cercariæ. In October I could find no cercariæ in several *Physopses* from a pool on the Umbilo river at South Coast Junction which, in the bathing season, swarms with the bilharzia parasites.

There would appear to be far less cases of bilharzia disease in Natal as a result of the active measures that have been taken to warn school children of its danger and as a result of the number of infected persons who have recently been effectively cured of the complaint; so that it is only reasonable to expect a correspondingly smaller pro-

portion of fresh-water snails infested with schistosomes; but a seasonal variation would appear to be the more likely explanation, because fewer snails are found infected with other trematode worms. The examples I collected from Avoca were obtained from the Umhlangana or its tributaries where they would be well exposed to possible infestation and have been found harbouring cercariæ in the summer months. For instance, in May, 1924, I found cercariæ resembling *Cercaria constricta* Faust in two examples of *Burnupia* from this same locality. I



Fifty-six rows of identical teeth in Isidora from Mauritius.



Marginal, lateral and central teeth of *Isidora tropica*.



Marginal, lateral and central teeth of *Burnupia stenochorias*.

believe that this is the first occasion that a species of this family of fresh-water snail has been implicated with the spread of distomes: though monostomes have previously been recorded in *B. trapezoidea* Bttg. on the Basutoland border of the Free State, and they also occur in *Burnupia* at Malvern. Some of the rediæ from which these distomes were escaping were equal in length to the diameter of the shell which harboured them, being 4 mm. in length.

Three different species of *Burnupia* have been described from this neighbourhood and, as the shells resemble one another very closely and are somewhat variable, even with Mr. Bryant Walker's careful description of the radulæ it is very difficult to be certain of the identity of infested examples.

In "The Ancylidæ of South Africa," which he published privately in 1923, he observes:—

"The remarkable differences that have recently been discovered in the radulæ of the various groups would certainly tend to strengthen the suggestions that have been made that the family as now recognized is not of homogeneous origin, but of diverse ancestry, and that the similarity in conchological characters should be considered rather as an example of parallel development than as indicating a common line of descent.

"Which of these theories is true can only be determined from a careful and critical study of the entire anatomy of all the genera, and, until that has been done, any general arrangement of the family based only on the characters of the shell and radula can, at the best, be considered only as tentative."

There is certainly a resemblance between the radulæ described by him for *B. stenochorias* (M. and P.) and those of *Physopsis africana, Limnæa natalensis, Isidora tropica* and *Planorbis pfeifferi*, and the resemblance is closer than that of the radula of *I. tropica* and an *I. ? borbonica* which has reached me from Mauritius.

The usual type of jaw in *Limnæidæ* would appear to be characterized by a central unicuspid or bicuspid tooth in from 120 to 150 lateral rows, about eight tricuspid lateral teeth on each side and as many as twenty-one marginal teeth in each row; though there are fewer teeth in the anterior rows. The cusps of the marginal teeth are all divided into a number of denticles. As the base of the central tooth is expanded, the base of laterals and marginals is oblique. There are a total of from six to nine thousand teeth in each individual snail. Although species as far apart as *B. stenchorias* and *I. tropica* possess such similar teeth; until the complete anatomy of the various species is studied and described, help might be forthcoming in the identification of the various hosts of *schistosoma*, were a careful study made of the radulæ of the various species found to harbour schistosomes, and this can readily be done under a one-twelfth magnification, once the radula has been separated from the rest of the snail and cleaned.

Extra-Intestinal Amœbiasis (M. Petzetakis, *Bulletin de l'Académie Royale de Med. de Belgique*, No. 8, September 27, 1924).—Two cases of cystitis and amœbic urethritis are described, both occurring in Egypt. Both patients complained of hæmaturia and urinary trouble. The first had suffered from dysentery two years previously. Examination of fresh urine showed small amœbæ 20-25 microns. Gram positive. Examination for gonococcus negative. The second patient did not remember having had dysentery. Examination of the stools for amœba negative, but living amœbæ were found in the urine, and numerous red globules. Morphologically, this amœba differs from *histolytica*, one of its interesting features is its polymorphism, for which reason the author calls it "*Entamœba polymorphe.*" The question as to how the amœba gained entrance to the bladder remains to be cleared. Injections of emetine completely cured both patients. During the author's researches on amœbic dysentery he has come across tubercular patients whose sputum, besides containing Koch's bacillus, showed the presence of living amœbæ. Injections of emetine caused remarkable amelioration in the general condition of the patient; fever ceased, and only rare amœbæ could be seen in the sputum.

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JANUARY 1, 1925.

A WHITE AUSTRALIA: IS IT A POSSIBILITY?

By SYDNEY J. SKERTCHLEY, J.P.

(*Continued from page* 340.)

CHAPTER V.

The "Histories" of the Future.

(70) But we cannot dismiss the subject so cavalierly as this. A few details must be given with regard to our own race, the Fair Whites, and our forebears, the Dark Whites. And it is essential to realize the view one must take of history.

(71) I have already said (par. 7, passim) that I shall neither deal with, nor be drawn into controversy upon, side issues. But I must clearly state what, in my opinion, constitutes a side issue. It has been necessary for me to study ancient and modern history deeply and critically, with the result that I think almost all history will have to be rewritten from the anthropologist's standpoint.

(72) Until quite recently, indeed, until the rise of such scholars as my friend Dr. Holland Rose, there was an unhistorical confusion between the facts of history and the interpretation of historical facts. The seers did not all render Mene Tekel Upharsin in the same terms. To take a very early illustration. In Kings we have the bare facts concerning certain reigns; in Chronicles the same ground is traversed "with advantages," and the misfortunes of monarch and subject are attributed to a distinct cause—and a political one. "He did evil in the sight of the Lord," is simply the euphemistic way of saying, "He did not come up to the views of the compilers of the Priestly Code." Whig and Tory, Cavalier and Roundhead, Colonna and Orsini alike suffer from political chromatic aberration.

(73) In dealing with the rise and fall of nations historians have attributed most of the vicissitudes that have befallen the nations of the earth to personal courage, wise administration, the sense *of* patriotism, the civilizing effect of commerce, the potency of high ethical standards, the ties of a common faith among psychical causes, and to climate and disease, and consequent lessened fertility and increased infant mortality among physical agents.

"Assyria, Greece, Rome, Carthage, where are they?" asked Byron, and the answer tacitly assumed by the historian, as by the poet, is that they became enervated by peace and prosperity, that pleasure took the place of national forethought, and so the dry-rot of inactivity laid the people open to the successful attacks of the stronger, and often ruder, folk who fell upon their flanks.

(74) This seems to me reading history upside down. Truly the alleged causes are fruitful for good and evil. But this is largely mistaking cause and effect. The question why decay sets in is left untouched. And, above all, it fails to discriminate between the decay of a race upon foreign and upon native soil. Nations (and this term is not necessarily the equivalent of races) undoubtedly do decay on strange ground. Witness the Akkadians in Babylonia and the Hindus in Java. Races may decay at their source of origin, but it would be hard to prove it. Rome and Greece are certainly not examples. But, unless climate deteriorates, a race most certainly tends to retain its strength and civilization at home. Herein we have, I think, the true key to the shifting of the centres of power and culture. It is an anthropological question almost purely. Races by their inherent tendency to decay on foreign soil develop the very tendencies which hasten their fall. The Fair Whites are as strong as ever on their own soil, so are the Dark Whites, and

both have degenerated when transplanted. Rome planted her colonies everywhere over the Empire. "Wheresoever the Roman conquers he inhabits," wrote Seneca the Roman, but Roman blood has vanished as completely from the colonia of the province of Asia as from Cologne of Germany or Lincoln of England. Yet were the Romans so certain of their colonizing power (and they exercised it longer than we have) that "in the time of Hadrian," Gibbon points out, "it was disputed which was the preferable condition, of those societies which issued from, or those which had been received into the bosom of Rome." Of Carthage it came to be written "delenda est," and such is the epitaph of every colonia from Euphrates to Severn.

(75) Each race seems to be endowed with certain possibilities, and to possess certain ineradicable limitations, and this our kindly man-and-brother altruists never grasp. East is east and west is west, and this old order changeth not. It is simply not true that the negro and the red man are what they are from want of opportunity or from neglect. They have been on earth as long as we have: the human race started at scratch. But here we are straying somewhat from our path. What I want to insist upon is that the creeping sickness, the sleeping sickness, that comes upon nations is not due primarily to effeminacy born of luxury, but that the desire for luxury and the consequent weakness are but symptoms of the incurable disease, nostalgia. The withers of the nation get unstrung in a strange land, the lax muscle that dreads the sword grip, the half-strung nerves that only tingle to lullabies are all premonitions of the coming day when the national anthem is dethroned by the requiem.

(76) But race is well-nigh immortal on its own soil. Witness the contiguous small states of Holland and Belgium, which not even the matchless genius of Napoleon could weld. Leyden is Dutch from the summit of her Burg, symbol of Rome's powerlessness, to the sluggish Rhine waters that wash her decaying palaces, emblems of her own powerlessness as a colonizer; while Brussels is Gallic from the toe-tip of her impudent Mannikin to the topmost finial of St. Gudule's spire. And where in either shall we find the dusky blood of Alva's Spanish hosts?

Annotations.

Classification of the Hemolytic Streptococci by the Precipitin Reaction (C. H. Hitchcock, *Journal of Experimental Medicine*, October 1, 1924).—A method is described for the preparation from hemolytic streptococci of extracts containing a soluble precipitating substance. By the use of such extracts, it is shown that nearly all members of this family yield a common precipitable substance. So far, therefore, as concerns the precipitin reaction, the hemolytic streptococci form a practically homogeneous group.

The Clinical Value of Bismuth in the Treatment of Syphilis (C. H. de T. Shivers, *Archives of Dermatology and Syphilology*, October, 1924).—Bismuth should not be substituted for arsenic in primary or secondary syphilis, except in patients resistant to arsenical treatment. Bismuth is effective, clinically, in the treatment of all forms of tertiary syphilis. In the treatment of neurosyphilis, bismuth in some cases has proved itself superior to arsenic. It should be tried in all patients that do not tolerate the arsenicals, and should be given with caution in all patients with faulty elimination. The absorption of this drug should be carefully studied, and, if possible, the number of treatments given should depend on the roentgenologic findings.

The Prophylaxis of Congenital Syphilis (Prof. J. Almkvist, *Hygiea*).—That congenital syphilis is derived from the mother is not yet established beyond all doubt, as tests carried out show. It is essential, however, that every pregnant woman suffering, or who has suffered, from syphilis should be given specific treatment during pregnancy. Children born of such women should be kept under clinical and serological observation, no specific treatment being attempted before definite signs of syphilis have appeared. How long this observation period should last is not stated, as it is not yet known how long congenital syphilis may be latent in an infant. Salvarsan is considered to be the most reliable remedy for preventing transmission of syphilis from mother to fœtus.

Studies on Oxidation and Reduction by Pneumococcus (J. M. Neill and O. T. Avery, *Journal of Experimental Medicine*, October 1, 1924).—Certain enzymes of pneumococcus are destroyed by oxidizing agents formed when sterile extracts of the cellular substances are exposed to air. The carbo-hydrate enzymes (sucrase, raffinose, inulase and amylase) are the most easily inactivated under these conditions, although the bacteriolytic enzyme is also reduced in activity. Similar treatment is without effect upon the active concentration of pneumococcus lipase and peptonase. The enzymes which are destroyed during the oxidation of unwashed cell extracts are themselves non-reactive with molecular oxygen. The actions by which they are destroyed seem to represent oxidations of a type similar to those proposed in previous papers for the oxidation of hæmotoxin and of hæmoglobin. A study has been made of the relative resistance of different pneumococcus enzymes to heat and to the action of hydrogen peroxide. The various enzymes may be arranged in the same order of relative resistance whether the rating be made from the standpoint of resistance to heat or of resistance to oxidation. Nevertheless, it appears that by a proper regulation of conditions of oxidation, certain labile constituents of a mixture

of cellular enzymes may be inactivated with less effect upon the activity of other constituents of the mixture than when inactivation is brought about by heat. From this may be concluded that when sterile extracts of the cellular substances of pneumococcus are exposed to the air, oxidizing agents are formed which destroy many of the cell enzymes.

The Blood Platelets in Pneumococcus Infections (H. A. Reimann, *Journal of Experimental Medicine*, October 1, 1924).—A study was made of the behaviour of the blood platelets during the course of pneumonia in man, as also in several rabbits experimentally infected with pneumococci. The number of platelets begins to diminish after the infection has become established. A thrombopenia occurs during the febrile period. Immediately following the onset of the crisis in lobar pneumonia or after the temperature begins to fall by lysis, the platelets begin gradually to increase in number. In the post-febrile period, the platelet count increases until the normal number is greatly exceeded, and there is a return to the normal number only after two weeks. Sequelæ, characterized by fever following pneumonia, are accompanied by a renewed diminution in the number of platelets. After subsidence of the temperature their number usually increases until the normal is again exceeded. The platelets in general are smaller and contain more granules during the thrombopenic stage of pneumonia. Intravenous injection of antipneumococcus serum during pneumonia ordinarily produces no variation in the number of platelets.

Abstract.

THE PREVALENCE OF EPIDEMIC DISEASE AND PORT HEALTH ORGANIZATION AND PROCEDURE IN THE FAR EAST.[1]

A COMMITTEE of experts was appointed by the League of Nations to visit the ports of India and the Far East to investigate the arrangements made for the prevention of communicable disease. The report is of considerable length and gives a detailed account of the procedure and conditions in a large number of ports, and an amount of very useful information on port sanitation work. The conclusions of the document are as follows: Bubonic plague is, all things considered, the most important ship-borne disease in the Orient. It is essentially a disease of rats, and the human case is, for all practical purposes, not infectious. There is abundant epidemiological information, based on a quarter of a century's experience, to justify the consideration of bubonic plague and pneumonic plague as two entirely separate and distinct epidemic diseases. It is extremely doubtful whether the plague bacillus *alone* can give rise to pneumonic plague epidemics. Epidemiological facts indicate the probability that pneumonic plague epidemics are caused by the plague bacillus in symbiosis with another organism. It is probable that this "hypothetical" organism will be found to be non-pathogenic for rodents. Bubonic plague is invariably spread from port to port by means of "rat-favoured" merchandise. The fact that one is able to incriminate such merchandise in the transference of plague infection from place to place implies the relative failure of the human being and his personal effects as vectors of infection. All anti-plague regulations and conventions should be framed with due regard to these facts. Of all forms of rat-favoured merchandise, grain is of chief importance with regard to the facilities given for the transference of plague infection. The control of the grain trade and the proper storage of grain are also synonymous with efficient plague preventive measures. If the association between rats and grain and other rat-favoured merchandize could be broken in the ports of the East, plague would cease to be a ship-borne disease. If due consideration be given to the attributes of the rat, it is possible to erect storehouses that can be kept automatically rat-free. Many "rat-proof" stores now in existence harbour a large rat population. Much more might be done than is done at present to control the rat population of such rat-proof stores; certain suggestions are contained in the note. The present condition of grain storage in many ports of the East is reprehensible and dangerous. Pending improvement in such matters, fumigation at periodic and frequent intervals of ships trading in the East will continue to be a matter of extreme importance. Further work is required to devise more satisfactory methods of fumigation than those at present in use.

The disinfestation before shipment of rat-favoured merchandise from plague-infected localities demands much more consideration than it receives. Such measures should, wherever possible, be taken at the port of departure. The rat-infestation of lighters, barges, employed in Oriental ports is sometimes excessive. Cases of plague among the floating population of certain ports occur from time to time. The periodic fumigation of lighters, barges, &c., employed in all Oriental ports is an important matter that rarely receives the attention it deserves. The history of the spread of plague in the East indicates that attention paid to the usual channels of infection could secure almost absolute immunity from plague, and that without vexatious restrictions to the free flow of commerce. The tendency of the disease to die out in large areas of the East, unless reinforced by repeated introduction of infection, accentuates the importance of preventing such reinfection. From the epidemiological viewpoint, human bubonic plague cases are merely an index of a co-existent rat epizootic. This index is inadequate, or may fail altogether, in circumstances dependent upon either (*a*) the nature of the rat-infestation of the port, or (*b*) the species of fleas that infest the rat. Such facts emphasize the absolute necessity for a systematic

[1] Abstracted from the Report presented to the Health Committee of the League of Nations by F. Norman White. 1923.

and thorough routine examination of rats in all Oriental ports.

British India is by far the most important reservoir of plague infection in the East. Java comes second. The prevalence of the disease in British India is decreasing noticeably in those provinces that have suffered most. The experience of Manilla, Formosa, Shanghai, which have been plague-free for many years, promises a successful issue to a serious attempt to eradicate plague infection from many other Oriental ports at present infected. This task might not be insuperably difficult, except perhaps in the case of Bombay, which, of all large ports in the East, possesses conditions most favourable to plague. The gradual extinction of foci of plague would, by diminishing sources of possible reinfection accelerate the natural tendencies to "die out" which characterize plague on either side of the Bay of Bengal and further east.

In most Oriental towns anti-plague measures are unsuccessful, largely on account of the antagonism of the population to such measures. The disinfection of houses and their contents is the most commonly practised of all anti-plague measures; it excites great antagonism and, as carried out, is of extremely doubtful utility. Suggestions are made regarding a new orientation of plague policy in many Oriental towns

Current Literature.

THE INDIAN MEDICAL GAZETTE.

Vol. LIX, No. 11, 1924.

Animals as Disseminators of Hookworm Eggs and Larvæ (Asa C. Chandler).—It is evident from experiments performed by the author and others that domestic animals constitute an important means of scattering hookworm eggs and larvæ. They do this either (i) by acting as hosts for the parasites, (ii) by transferring fæces or earth containing eggs or larvæ on their feet or other parts of their bodies, and (iii) by ingesting egg-containing fæces and scattering the undamaged eggs in their own droppings. Although *Ankylostoma duodenale* will occasionally develop to maturity in dogs or cats, these animals are negligible as hosts of human hookworms. Pigs harbour a species of necator which closely resembles the human species and is probably only a hostal variety of it. They also occasionally harbour *A. duodenale*. The spread of eggs and larvæ by the feet and bodies of domestic animals and by the scratchings of chickens is obvious. The value of the elimination of this means of dissemination appears greater in view of the absence of active lateral migration on the part of the larvæ themselves. The passage of eggs unharmed through the digestive tract of pigs, rats, and dogs has been proved. In chickens a high percentage is destroyed, probably in the gizzard. Since these various animals feed very commonly on human fæces, this constitutes an important means of dissemination. It has been shown that after feeding on human fæces viable hookworm eggs are passed for at least seventy-two hours in the droppings of these animals. In view of these facts the devouring of fæces by pigs, rats, dogs or other animals, with the possible exception of chickens, cannot be looked upon as desirable on account of the destruction of so much refuse, but rather of a very dangerous process resulting in the dissemination and not the destruction of the most injurious component of the material, namely, the eggs of human intestinal parasites.

Indian Santonin Extracted from the Indian Species of Artemisia maritima (R. N. Chopra and A. C. Chandler).—Santonin extracted from *A. maritima* Linn (*A. brevifolia* Wall), which grows in the mountains of Kashmir (Baltistan), closely resembles in its physical, chemical and physiological properties the santonin imported from Europe. It satisfies all the tests laid down in the British and United States pharmacopœias. Its therapeutic efficacy is just as good. The present market price of the Indian santonin is Rs. 670 per pound, but if it is worked on a larger scale the price could probably be considerably reduced.

A Preliminary Note on the Pharmacological Action and Therapeutic Properties of Kuth Root—Saussurea lappa (R. N. Chopra and Captain Premankur De).—The active principles of *S. lappa* are (*a*) an essential oil; (*b*) a glucoside; (*c*) an alkaloid. The essential oil and the glucoside are pharmacologically active bodies. The alkaloid is less active. The essential oil has strong antiseptic and disinfectant properties especially against the streptococcus and staphylococcus; the alkaloid and the glucoside have little or no effect in this direction. The glucoside causes a small but persistent rise of blood pressure; the essential oil does this in a lesser degree. Both the glucoside and the esssntial oil have a slight but definite broncho-dilatory effect. The alkaloid is inactive in this respect. The powdered root and the alcoholic extract are expectorant and are beneficial in asthma. They cut down attacks and reduce their frequency. The drug has no anthelmintic properties.

Surgical Sundries (C. A. M. Gourlay).—Anæsthesia is a subject of importance to all medical men, whether dealing with accidents or disease. There have been cases of patients dying from shock where anæthesia has not been used. It is the duty of the doctor, nurses, &c., to diminish the factors of shock (anxiety, fear, pain, hæmorrhage and sepsis) as far as possible. Fear is easily overcome by the injection of one-sixth grain of morphine before the patient is carried from his bed to the theatre. A local anæsthetic should be used to ease pain; there is then no need for a heavy dose of chloroform. Some useful notes are also given with reference to the treatment of fractures.

Notes on Malaria in Hill-Stations in or near the Himalayas (C. Strickland).—The incidence of the epidemic in Kurseong is from April to July inclusive, while in Shillong it is from the middle of May to the middle of October. Malaria has been attributed to *Anopheles maculatus* in both places. The difference in the two places of the time of onset is probably due to meteorological conditions which influence the development of the parasite in the mosquito. The difference in the duration of the malady depends on the different geological structure of the two tracts. The only means of preventing malaria, according to the author, is a system of contour hill-foot drains, and as maculatus will breed in these as well as in the swamps, the drains must have either sub-soil pipes laid in them or a ribbon of jungle allowed to grow up over them, which will prevent maculatus breeding inside. If rubble be laid in such drains the effects are likely to be disastrous.

The Relative Value of Diagnostic Methods and Evidence of Cure in Kala-azar (H. E. Shortt).—The author gives a list of the methods used in the diagnosis of kala-azar in the order of relative reliability, as follows: (i) Culture of spleen or liver puncture fluid on N.N.N.; (ii) culture of the peripheral blood by Row's method or on N.N.N.; (iii) examination of spleen or liver puncture films, no cultures taken; (iv) the aldehyde reaction; (v) examination of peripheral blood films, no cultures taken. With regard to cure, where the parasites have been reduced as a result of treatment, the first method is most reliable.

Some Observations on the Cholera Epidemic in Bombay, 1923 (Dr. Purshotamdas T. Patel).—Cholera is mostly introduced into Bombay from other parts of India where it is endemic. In 1923 the epidemic started in June amongst Haj pilgrims who came in large numbers from Bengal side to go to Mecca, mostly aged and infirm; mortality, fifty-eight per cent. Inoculation with cholera vaccine stopped the epidemic after two weeks. A week later a local focus of infection revealed itself. During the months of July and August, 151 cases were admitted into hospital. The disease was spread chiefly by personal contact, food and flies. Death amongst the local cases was twenty-six per cent. This diminished percentage of mortality is due to the treatment used on the lines of Sir Leonard Rogers. It would be still further reduced if the cases were sent early to hospital.

Notes on a Few Cases of Cholera Treated by Various Methods (S. Nath Chatterjee).—The essential oils mixture, though it has diuretic properties and some stimulating effect, probably cannot prevent the absorption of toxins, either chemically or mechanically, and if there be such action it is not sufficiently strong, as is urgently required in these cases; also, it is doubtful whether it possesses any bactericidal property. Kaolin acts in two ways: (*a*) it prevents absorption of toxins mechanically by coating the intestinal wall very quickly, which gives an opportunity of treating the complications, if any; (*b*) it most probably inhibits the growth of proteolytic bacteria in the bowels and favours the growth of acid-forming bacteria—hence, indirectly acting as a bacterial agent. For these reasons, besides its cheapness, and its simplicity in administration, kaolin is to be preferred to the essential oils. It appears that kaolin acts very well when given with permanganate. The two combined form one of the most simplest methods of treatment suitable for villages, for melâs and in combating the epidemic; it is applicable to cholera in all its stages.

A Note on the Cause of Pemphigus Contagiosus (*Manson*) (J. Cunningham and S. Ramakrishnan).—This skin affection is very common in Madras during the hot weather, especially in children. The type resembles pyosis mansoni described by Castellani (1919). Both extremities and, less commonly, the axilla are the most common sites of infection. The inguinal region is rarely affected. A streptococcus has been found in numerous cases by the author which is believed to be the primary cause of the affection. All the strains isolated gave identical fermentations in Holman's carbohydrated medium (*Streptococcus subacidus*). The affection is easily cured by means of a vaccine prepared from this organism.

The Aldehyde Test in Schistosomum hæmatobium *Infection* (R. B. Lal).—The aldehyde reaction was tried in cases which showed ova of *S. hæmatobium* in the urine. The methods employed were: (i) Fox and Mackie, 1921; (ii) Modification of Napier, 1922; (iii) Exact technique of Napier, 1922. There is a probability of the aldehyde reaction being positive in some cases of *S hæmatobium*. Much reliance cannot be placed on methods (i) and (ii). The diagnostic value of the aldehyde reaction might become doubtful in places like the Sudan where both kala-azar and *S. hæmatobium* infections prevail, and in cases where the latter disease is complicated with malaria and similar fevers the test cannot be relied upon.

Medical News.

UNITED STATES PUBLIC HEALTH SERVICE.

Medical Advice by Radio.

For some years the Public Health Service has maintained a free medical service to ships at sea having no physicians on board, and many stories of its usefulness in emergencies have been recounted.

This Service which has been established on the Atlantic and Pacific coasts and on the Gulf of Mexico is being extended to include shipping on the Great Lakes. Arrangements have been made for Marine Hospital No. 6 at Cleveland, Ohio, and Public Health Service Relief Station No. 327 at Sault Ste. Marie to respond to requests from masters of lake vessels for medical advice when needed.

Original Communications.

PREVENTION AND TREATMENT OF MALARIA.

By W. E. Deeks, M.D.

General Manager, Medical Department, United Fruit Company, New York.

Clinical observations made on patients suffering from general paralysis, dementia præcox, disseminated sclerosis, &c., in whom malarial infection was introduced for therapeutic purposes, have an unusual interest. This method of treatment has been in vogue, in European countries particularly, during recent years, having originated with Wagner-Jauregg in Vienna. A sufficient number of cases have been treated to enable clinical observers to draw fairly accurate conclusions in regard to several hitherto mooted points in the prevention and cure of malaria.

Warrington Yorke and J. W. S. Macfie have reported their observations on 146 cases; and their findings coincide in general with those of other European observers. In their group of treated cases, 105 were inoculated by virulent blood: chiefly subcutaneously —occasionally intravenously. In six cases *Plasmodium malariæ* was inoculated, in one case *P. falciparum*, and in ninety-eight cases *P. vivax*. In addition to these, forty-one cases were infected with *P. vivax* through the agency of infected mosquitoes (*Anopheles maculipennis* and *A. bifurcatus*).

These observations made under direct scientific control invite discussion on the following phases of malaria prevention and cure: (1) Immunity; (2) Quinine prophylaxis; (3) Treatment of primary infections; (4) Treatment of chronic infections or relapses.

Immunity.

Some of the observations which refer to the question of immunity may be briefly summarized:

(1) In four of the six cases inoculated with *P. malariæ* parasites appeared in the blood from the sixteenth to the twenty-first day after inoculation; in one, on the forty-fourth day; and in one, on the fifty-fourth day.

(2) In those inoculated with *P. vivax* the parasites appeared in the blood in from six to twenty days, and the fever appeared in all cases about the same time, only occasionally preceding or following, by one or two days, the finding of the parasites.

(3) In the ninety-eight cases inoculated with virulent blood nine failed to become infected on the first inoculation. Occasionally repeated inoculations failed to infect. Wagner-Jauregg noted the same in his series of inoculations and met with a few cases which he was unable to infect after three or four inoculations.

(4) Van Loon and Kirschner, of Batavia, report as follows: "A great percentage of the patients, who had lived in the Tropics from their birth, and who were repeatedly (four to five times) intravenously, and afterwards also subcutaneously, inoculated with relatively large quantities of benign tertian blood, appeared to be absolutely immune; others fell ill, but slightly only, and recovered spontaneously after a few attacks."

(5) All of the forty-one cases bitten by mosquitoes became infected. S. P. James, however, reports two cases of failure to infect by this method.

(6) In four of the ninety-eight infected spontaneous cure resulted from five to fourteen days, and no relapses occurred in from three to twelve months' observation.

Immunity to malaria evidently exists in varying degrees in the human subject, as evidenced by the following facts:

(1) That notwithstanding the direct inoculation of 2 c.c. of virulent blood containing approximately a million parasites, nine out of ninety-eight cases failed to become infected and required three to four inoculations to bring about infection. In some cases infection failed after four inoculations, which demonstrates that definite immunity exists in some individuals, particularly among those long resident in tropical malarial districts.

(2) S. P. James has seen two cases whom he was unable to infect by mosquitoes which showed, on subsequent dissection, numerous sporozoites in the salivary glands.

(3) In four of the six cases inoculated with *P. malariæ* parasites appeared in the blood from the sixteenth to the twenty-first day after inoculation: in one, on the forty-fourth day; and in one on the fifty-fourth day. Although the same quantity of virulent blood containing quartan parasites was injected in different individuals, the incubation period varied from sixteen to fifty-four days—that is, before parasites appeared in the peripheral blood accompanied by fever.

(4) In four of the ninety-eight cases inoculated with tertian parasites, spontaneous recovery took place in from five to fourteen days. In the remaining cases of this group the incubation period varied from six to twenty days.

Thus in both quartan and tertian infections different degrees of resistance are seen. In other words, it requires more time in some individuals than in others for the development of sufficient parasites to produce symptoms; or, what is much more probable, the agencies concerned in the development of immunity in some individuals is stronger than in others, thus delaying or altogether preventing the onset of symptoms.

If immunity, partial or complete, were non-existent, undoubtedly the population in severely malaria-infected districts would be completely exterminated in a short time.

My experience in Panama confirms the probability of the development of immunity against malaria. Before Panama was sanitated, anopheles were present in large numbers and new-comers were constantly infected, whereas it was seldom met with in the resident population. From 1906 to 1914 I was frequently called in consultation to see members of the adult resident population, and do not recall a single individual whose illness could be directly attributed to malaria. It was not uncommon, however, to meet with malaria in children or new-comers. Several of the adult residents suffered from organic affections requiring operations, but in most instances these were not followed by malaria exacerbations necessitating the administration of quinine.

Furthermore, I have occasionally met with individuals, past middle life, who said they had never suffered from fever, although they had lived in malaria-infected districts in the tropics for fifteen or more years.

We know that partial immunity is common. An individual may harbour malaria organisms in his blood for years, and yet not be conscious of any discomfort until his general resistance is lowered through some influence, and then a fresh exacerbation of fever ensues.

Yorke and Macfie further demonstrated that immunity, partial or complete, established against one species of the malarial parasite, does not prevent infection from the other species; but it does protect him from fever exacerbations if he is again re-infected with the same parasite by inoculation, or through mosquitoes. Therefore, partial or complete immunity against malaria infection exists or can be developed; but we do not know how, or our problem of prevention and cure would be greatly simplified.

Quinine Prophylaxis.

In regard to the prophylactic use of quinine in preventing infection by mosquitoes, the results from thirty-four cases are shown in the following table:

Observations made on the Effect of Prophylactic Quinine.

From Warrington Yorke and J. W. S. Macfie.

Number of cases	Prophylactic quinine: Daily dose in grains	Prophylactic quinine: Number of days given: Before infected mosquitoes fed	Prophylactic quinine: Number of days given: The day of, and after, infected mosquitoes fed	Number of infected mosquitoes known to have bitten each case	Result	Incubation period from day of infection: Fever	Incubation period from day of infection: Parasites
5	5	—	7	2-4	All infected	12-17	14-16
1	5	1	8	2-4	Infected	20	20
2	10	5	9	2-4	Both infected	18-20	18-20
3	30	—	3	1-3	All infected	11-14	13-14
1	30	1	7	1	Not infected	Observation period six weeks	
1	10	—	35	1	Not infected	Observation period two months	
1	10	—	28	3-4	Not infected	Observation period six weeks	
3	10	—	21	2-4	None infected	Observation period three months	
6	5	—	56	1-4	None infected	Observation period after cessation of Quinine, two to three months	
3	5	7	21	2-5	None infected	Observation period six weeks	
2	5	14	14	1	None infected		
1	5	7	14	1	Not infected		
3	5	—	14	2-5	None infected		
1	5	14	10	2	Not infected		
1	5	—	10	1	Not infected		

It is to be noted:

(1) In six cases, 5 gr. of quinine given daily on the day of infection and for about a week subsequently, failed to prevent infection.

(2) In two cases, 10 gr. given five days previous to infection and for nine days subsequently, also failed to prevent infection.

(3) Three cases given 30 gr. daily for three days, beginning with the day of infection, became infected subsequently.

On the other hand

(4) In one case, 30 gr. administered daily, beginning the day previous to, and continuing for seven days subsequent to exposure, prevented infection.

(5) In five cases, 10 gr. daily, administered on the day of infection and for from three to five weeks subsequently, prevented infection.

(6) In seventeen cases, 5 gr. given daily, for from ten to fifty-six days, prevented infection; seven of these cases had taken 5 gr. daily from one to two weeks before infection, the remaining ten beginning with the day of infection.

From these observations we are justified in drawing the following conclusions:

(1) That quinine, given prophylactically in daily doses of from 5 to 30 gr., and for two or three days subsequent to exposure, does not prevent infection; in other words, that quinine has apparently no action whatever upon the sporozoites, and is destructive only to the trophozoites.

(2) That the absence of positive malarial findings in the cases recorded, in observations 4, 5 and 6, as not being infected, does *not* by any means *prove* that the cases were not infected; on the contrary, we are justified in drawing the conclusion that the infection was cured by the subsequent administration of quinine over a period of from ten to fifty-six days.

Dr. H. N. Hanschell records a series of exceedingly interesting cases which confirm these observations. He had twenty-nine white men under his medical care in Central Africa. Of this number, nine slept under mosquito nets 3 ft. wide. The other twenty slept under mosquito nets 18 in. wide—too narrow for them to avoid exposing their arms and hands to the bites of mosquitoes through the net. All of the twenty-nine men took prophylactic quinine in the form of a 5-gr. tabloid of quinine bisulphate with every evening meal, over a consecutive period of from seventy-eight to 102 days. No infected anopheles were seen about the camps for the greater part of this period. From then on, all those sleeping under 18-in. nets contracted subtertian malaria, the mosquito bites being observed in all instances on the arms and hands which had become exposed when the narrow nets were used. None of the nine men who slept under 3-ft. nets contracted the infection, nor was there any evidence that they had been bitten by mosquitoes. This experience of Dr. Hanschell confirms the observations made by York and Macfie, i.e., that quinine for prophylactic purposes does not prevent infection.

If these conclusions be true, then by the exhibition of quinine for prophylactic purposes we only cloud the issue, and in many cases are unable to determine whether people are infected or not. They may become

infected, receive only sufficient quinine to develop a temporary immunity, and remain carriers without symptoms but capable of spreading infection to others. Would it not be a better method of procedure if we permitted them to develop symptoms and thus definitely demonstrate that the organisms are present in the peripheral blood? We could then institute efficient treatment, under proper supervision, and the probabilities are that not only the individual but the community would be benefited more than by our present methods.

It has generally been considered that quinine destroys not only the sporozoites, but also the malarial organisms when they are free in the plasma, directly after sporulation, and consequently that the best time to administer it, in order to obtain the optimum results, is either about the time of infection or of sporulation, before the liberated organisms have had time to enter the red cells.

The evidence produced above proves almost conclusively that quinine has no effect on the sporozites, and probably not on the organisms in the plasma after sporulation, but only after they have entered the red cells. As stated, this is contrary to the opinion which has been generally accepted.

We have used quinine quite extensively for prophylactic purposes, giving from 15 to 20 gr. twice a week, and have noted that the number of hospital admissions was greatly reduced, and consequently also the rate of serious morbidity. Some recent work in one of the divisions of the United Fruit Company plantations has demonstrated that in those who had been taking 20 gr. twice a week for an extended period of time, infection was present, but that this amount of quinine apparently was sufficient to limit the parasitic development, prevent symptoms, and establish tolerance, as these people did not seek hospital treatment as frequently as they had done previously.

Manson-Bahr claims that there must be at least fifty parasites to the cubic millimetre in order to produce symptoms; and Darling believes that at least twelve gametes to the cubic millimetre are necessary in order to infect mosquitoes. Quinine, in prophylactic doses, may destroy a sufficient number of parasites subsequent to infection to prevent the development of symptoms, although the parasites are still numerous enough to be readily detected in the peripheral blood. In the same manner the gametes could be controlled to such an extent as to prevent mosquito infection. With such results possible, the continuous administration of quinine, under certain conditions, is not only justified but commendable.

Treatment of Primary Infections.

As has been fully demonstrated above, primary infections are readily cured by small daily doses (5 to 1 gr.) given over comparatively short periods (ten to fourteen days) or by larger daily doses (30 gr.) over even shorter periods (seven to ten days). In this connection the following observations were made:

(1) In sixty-one inoculated cases treated by the oral administration of quinine sulphate in solution, 30 gr. daily for three consecutive days, only one relapse occurred during an observation period which varied from four to eighteen months. Wagner-Jauregg, Mühlens and Kirschbaum, Grant and Silverston, and others, report similar results.

(2) In thirteen other cases treated in a similar manner, and subsequently given two or three injections of novarsenobillon, one relapse occurred during a similar observation period.

(3) In the series of forty-one cases infected by mosquitoes, thirty cases were given 30 gr. of quinine daily for three consecutive days, and five relapsed within a period varying from two to six months, the indication being that mosquito infection is more difficult to cure than infection through inoculation, probably because immune bodies were injected with the parasites.

(4) In Hanschell's twenty cases of subtertian malaria, referred to above, the quantity of quinine bisulphate (5 gr. daily) which had been given for a period of from seventy-eight to 102 days, for prophylactic purposes, did not prevent infection. Nevertheless, after the appearance of parasites in the blood it was necessary only to slightly increase the daily dosage for three or four days until a total quantity of 30 gr. had been given orally, and in addition one intramuscular dose of 9 gr., in order to effect a cure. Most authorities admit, moreover, that the subtertian infections of malaria respond more readily to quinine than quartan and tertian infection.

In this connection, I wish to record the following experience of a friend of mine. Before Port Limon, Costa Rica, was sanitated he resided there for a period of about twenty years. At that time malaria and yellow fever were endemic. In his early experience, he contracted malaria, took very little quinine and developed a chronic intermittent fever, which persisted several weeks after he came North to recuperate. When he recovered his health, he returned to Port Limon and again contracted malaria: he then adopted the following method of treatment:

At the onset of the chill he took a hot foot-bath, drank quantities of hot tea, and covered himself with a number of blankets. To favour free perspiration he retained the heavy covering during the hot and sweating stages. The same night he took two compound cathartic pills, and the next morning (about fifteen to eighteen hours after the onset of the chill) began to take his quinine, 15 gr. in powder (wrapped in tissue paper) every hour, until he had taken 90 gr. Invariably this terminated the attack, and he remained perfectly well for from nine months to two years, that is, until he again became re-infected. He treated most of the men of his camp in the same manner, with invariably excellent results. Undoubtedly these were primary infections, as will be demonstrated later on when the treatment of chronic infections is discussed. It is to be noted that the quinine administration was not begun until the spores had had plenty of time to enter the red-blood cells.

A careful study of the table, as well as these observations, favours the conclusion that in the treatment of primary infections heroic doses (30 to 60 gr. daily) of quinine should be given for the first two or three days, and reduced doses for an additional

week; or if small doses (5 to 10 gr. daily) are given, the treatment should be continued for from ten to fourteen days or longer, in order to effect a cure. The period of treatment would be largely determined by the physical condition of the patient.

In my early experience in Panama we were accustomed to give 10 gr., three times daily, until the fever disappeared; and after one or two days of normal temperature the patients were allowed to return to work. It was found that relapses were exceedingly frequent. We then changed our method, and gave 15 gr., three times daily, until the temperature became normal; and we insisted on our patients remaining in the hospital for at least five days after normal temperature, during which time 10 gr. of quinine were given three times daily, and a very liberal diet ordered. Under this method of treatment the number of relapses was greatly diminished, and the results were so striking that this procedure was officially recognized and adopted as routine treatment. In the light of these recent observations, the occurrence of so few relapses after this method of treatment is adopted can be readily explained by the fact that undoubtedly the majority of these cases were primary infections. We thus have evidence to show that in the treatment of primary infections heroic doses of quinine for the first few days, or smaller doses continued over a period of two weeks, should result in cures in the vast majority of cases.

Chronic and Relapsing Cases.

In these cases we have a different clinical picture. The patients are anæmic. Not only is the number of red cells reduced below normal, but there is also a loss of hæmoglobin of from 10 to 50 per cent. in the red cells remaining. From this we may infer that either some hæmolytic action is taking place, or else that the functions of the hæmatopoietic organs are affected. The spleen is enlarged, particularly in the tertian and quartan infections, the function of the liver and kidneys is frequently interfered with, and occasionally these organs are organically diseased. In general, there is a condition of reduced resistance on the part of the patient.

Not infrequently other complicating diseases contribute to the lowering of vitality which is manifestly present. These are the cases which tax the ingenuity of the practitioner if he is to bring about complete convalescence. That we cannot get rid of the malaria infection in many of these cases by the administration of quinine alone is patent to everyone who has concerned himself with this treatment. The following observations confirm such a statement:—

At Liverpool, during the World War, two-day courses of treatment were given in doses of from 5 to 120 gr. daily; the results, as well as the methods of administration, are shown in Table 2.

Furthermore, twenty-nine cases were given 30 gr. of quinine daily for eight weeks, and 83 per cent. of them relapsed within an observation period of two months.

These were undoubtedly cases of chronic malaria. From these observations we must conclude: First, that brief courses of quinine, no matter how large the dosage, are without value in the treatment of chronic cases; and secondly, that prolonged courses of large doses of quinine, continued over a period of eight weeks, cure only a small percentage of chronic cases. These conclusions are in marked contrast with the results obtained in primary infections—a practical point which should be stressed.

Table 2.—Summarising the Result of Various Short Courses of Quinine in the Treatment of Simple Tertian Malaria obtained at Liverpool during the War: Post-Treatment Observation Period at least Two Months.

From Warrington Yorke and J. W. S. Macfie.

Daily dose in grains and Salt of quinine used	Method of administration	Number of consecutive days quinine given	Number of cases treated	Number of relapses	Percentage of relapses
5 sulphate	Oral	2	12	11	91.6
5 hodrochloride	Oral	2	18	18	100
10 sulphate	Oral	2	10	10	100
15 sulphate	Oral	2	14	14	100
15 hydrochloride	Intra-muscular	2	20	19	95
15 alkaloid	Intra-muscular	1-2	38	31	81.6
30 sulphate	Oral	2	14	14	100
45 sulphate	Oral	2	12	9-12	75-100
60 sulphate	Oral	2	12	7	58
90 sulphate, 1st series	Oral	2	76	29	38.1
90 sulphate, 2nd series	Oral	2	89	84-86	94-97
120 sulphate	Oral	2	15	9	60
30 bihdydro-chloride	Intra-muscular	12	30	26	86.6

In order to obtain results in this class of cases, in addition to quinine, we must utilize all remedial agents which will tend to increase the natural resistance of the patient as well as combat complicating, debilitating conditions or infections, as apparently quinine alone in any amount over any period of time will not cure some of these chronic relapsing cases.

Among the numerous complicating diseases, in chronic cases resisting quinine, syphilis must be considered. I have repeatedly drawn attention to the fact that this condition must be treated simultaneously with the malaria infection, or our efforts to cure the patient will be futile. It is in this class of cases that the arsenical preparations are of great value, and the good results obtained have often been misinterpreted. Arsenic does not cure the malarial infection, but assists materially in overcoming the debilitating influences of the complicating syphilis. In the same category as syphilis we may mention hookworm disease, tuberculosis, and all other local or constitutional conditions which tend to lower the resistance of the patient.

Because of the anæmia so generally present, the administration of the arsenical and iron preparations are indicated, and our method of giving two Aiken tonic tablets three times daily over a period of two or

three months has proved to be a very useful measure. The formula is :—

Quinine sulphate	1 grain
Reduced iron	$\frac{3}{4}$,,
Strychnine sulphate	$\frac{1}{30}$,,
Arsenious acid	$\frac{1}{30}$,,
Ext. gentian	$\frac{1}{4}$,,

In some of the more stubborn cases every effort to improve the vitality of the patient must be resorted to, and frequently it has been found that a change of climate has proved to be of undoubted value.

It is advisable for us to give consideration to the preparations of quinine which should be used, and the best methods of administration. As to the first—we may administer quinine in the form of the insoluble alkaloid ; or its salts, the sulphate, bisulphate, hydrochloride or bihydrochloride. Some also recommend the tannate, tartrate, or lactate salts, as well as euquinine (an ethyl-ester of quinine-carbonic acid) which are very insoluble preparations, hence almost tasteless, and consequently of value in selected cases. The quinine alkaloid is also practically insoluble. The sulphate is soluble to the extent of one part in 800 parts of water, and the hydrochloride to the extent of one part in thirty-five parts of water. When acid is present in excess these salts enter into solution readily ; the bisulphate one in eighteen parts, and the bihydrochloride in less than its own weight in water.

For hypodermic use, the bihydrochloride salt is to be preferred because of its solubility, but if the solution has excess acid the injection is very painful. It is better therefore, to use the neutral salt, well diluted, at body temperature, and administer it very slowly.

Sir Leonard Rogers recommends cinchonicine bihydrochloride for intramuscular injections.

From observations made recently in our hospitals, the insoluble salts of quinine are as effective therapeutically as the soluble preparations. It is generally believed, however, that quinine in solutions acts more quickly than the insoluble preparations. Solutions must also be used with patients unable to swallow pills, tablets or capsules. Care must always be taken to see that pills and tablets are readily friable, otherwise they will pass through the alimentary tract without absorption.

In the treatment of malignant cases of malaria, quinine must be introduced by the needle ; either deep subcutaneously, intramuscularly, or intravenously. The solutions should always be well diluted and introduced very slowly. For intramuscular use, the dilution should be at least one to ten, or twenty. After the injection, the tissues into which the quinine is introduced should be thoroughly massaged, and then a hot-water bottle should be applied, to favour absorption—otherwise tissue necrosis may result. For intravenous use, the dilution with normal saline solution should be still greater, otherwise emboli may result and cause sudden death.

Undoubtedly the intravenous use of quinine is indicated, and is to be selected, when prompt action is necessary in order to save life. Howell claims that it takes about half a minute for a circulating particle of blood to return to any one point, and as the intravenous injection takes longer than this, all infected circulating cells are brought into direct contact with the quinine solution during the period of injection and only those escape which are plugged in the capillaries of the viscera.

It is not definitely known how quinine acts in the cure of malaria, nor what becomes of the major part ingested, but in this connection the following quotation from Cushny is suggestive :

"Quinine appears in the urine within a short time (fifteen minutes) after its exhibition by the mouth. and it continues to be excreted by the kidney in some quantity during the next twenty-hours, and in smaller amounts up to about seventy two hours. Only about one-third of that absorbed appears in the urine, however, and only traces have been found in the other excretions ; so that two-thirds or more undergoes complete destruction in the tissues. When quinine is injected into the subcutaneous tissues some of it is deposited locally and only slowly redissolved, so that traces may be found in the urine for a week or more. When it is injected into the blood it leaves the plasma within a few minutes, becoming attached to the corpuscles in some firm combination from which it is difficult to liberate it. It does not accumulate in any of the organs to any significant extent. It is sometimes stated that a tolerance to quinine may be acquired by prolonged treatment, but this seems to be incorrect, the same symptoms occurring and the same amount appearing in the urine after prolonged administration."

As based on these observations, the following measures would appear reasonable for the handling of labour camps in malaria-infected districts :

(1) Every effort should be made to obtain a maximum control of mosquito production (not overlooking the economic consideration of costs) by the methods now in general use. These include selection of sanitary camp-sites ; and the drainage of pools. Where the latter is not possible, pools should be filled or larvicided by means of petroleum products or Paris green. Seepage areas must be taken care of, and rank vegetation cut as often as necessary.

(2) Dwellings should be screened for those able to appreciate the value of this measure, and who will care for the screening. Mosquito bars also serve a very useful purpose, if properly constructed—particularly for temporary use. Unless the mosquito net has a width of at least three feet, during sleep the bare arms or legs may come in contact with the net and thus be exposed to mosquito bites. Furthermore, the net should be constructed in the form of an inverted sack and should be securely fastened at the bottom so as to prevent the entrance of mosquitoes. The use of these methods of protection against the biting of mosquitoes applies particularly to the literate and more intelligent members of the community. In order to obtain the maximum results, in conjunction with these measures, these conditions should obtain.

(*a*) Inhabitants should know that anopheles mosquitoes feed only between sunset and sunrise, and

that during this period people should remain behind the screens or bars. Some authorities believe that repellents, such as creosote, offer a satisfactory method of protection.

(*b*) The people should have more or less definite information in regard to the premonitory symptoms of the malaria infection, which manifest themselves in the form of lassitude, headache, nausea, muscular pains and fever.

(*c*) They should be familiar, also, with the recognized methods of treatment, the amount of quinine that should be taken daily, and the period over which it should be taken in order to effect a cure.

(*d*) They should further realize that, if the results of treatment are not satisfactory, skilled medical advice should be sought.

(3) In dealing with the illiterate labourers we are confronted with a more serious problem. They will not appreciate nor take care of the screens or bars, nor observe other precautionary measures. This class of people should have daily or semi-weekly supervision from a trained attendant, who would take their temperatures and obtain brief histories of physical complaints. Those who are suspected of having a malaria infection should be referred to a hospital or sick-camp for daily treatment under direct medical supervision. A trained attendant could supervise in this manner a large number of labourers if they were located in closely adjoining camps with convenient transportation. This method of handling the situation would obviate the necessity of giving large quantities of quinine for prophylatic purposes.

(4) In camps where considerable infection is indicated, a careful survey is strongly recommended, and all those found infected should be treated daily—either in sick-camps or in hospitals. The measures to be adopted would depend upon (*a*) the degree of infection, and (*b*) the general physical condition of the patient.

(5) In regard to the chronic relapsing cases: Everything must be done to increase the resistance of the patients by treating complicating diseases or conditions concurrently with the administration of quinine orally or hypodermically, and this necessitates hospitalization under direct medical supervision.

(6) The continous administration of quinine to all individuals in a camp is justifiable only when there is a high percentage of infection, and when large numbers of infected mosquitoes are present in the neighborhood.

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Transactions of the Royal Society of Tropical Medicine and Hygiene, March 20, 1924.

CORRECTION. — In Dr. Castellani's paper in January 1 issue, "Observations on Some Diseases of Central America," p. 2, col. 2, line 8, read *all* instead of "most."

THE RESULTS OF THE NOGUCHI TREATMENT OF THE PROPHYLACTIC MEASURES EMPLOYED IN THE 1923 YELLOW FEVER EPIDEMIC IN BELIZE.

By Colonel JAMES CRAN, O.B.E., M.D.,
Belize, British Honduras, C.A.

IN 1921, in Belize, there occurred an outbreak of yellow fever, which is of interest in that the Noguchi serum and vaccine were extensively used, and accurate records were kept.

The outbreak occurred about a mile from the outskirts of the town, in a large secondary college in the lee of the prevailing breezes.

The pupils consisted of upward of 100 day scholars from Belize, and a similar number of boarders from the neighbouring Republics of San Salvador, Guatemala, Mexico and Honduras. In the three former countries cases of yellow fever were known to have occurred within the previous twelve months.

Nearly all the boarders returned by sea to the college in the month of July, after the summer vacation, and there can be little doubt that an ambulatory case of yellow fever returned amongst them.

That Belize has been so free from yellow fever in past years in spite of its propinquity to, and daily intercourse with, infected countries is probably due to its rigid enforcement of passenger inspection.

Owing, however, to the number of arrivals at the college, and the distance from the reporting station (over two miles), permission was given to the infirmarian, an intelligent and experienced man, to take the temperatures and report any above normal. Inasmuch as the officer was one of the early victims himself, his statement could not be taken, but it is likely that there might have been a case which he failed to notice, or which was so similar to those he was treating as malaria, that his suspicions were not aroused as the possibility of its being anything else. However, on August 18, the college physician was called, and on the following morning he reported his suspicions to the health authorities. The principal medical officer on arrival at the college found three well-marked cases of yellow fever, one in its sixth day, moribund, and each of the other two in its fifth day.

The infirmarian himself had been sick for four days, although still performing his duties; and his clinical symptoms were not so definite, as he was suffering from chronic malaria and nephritis. In addition, three other cases were also found, a total of seven. All were immediately given Noguchi serum intravenously, of which fortunately there was a supply on hand. The four cases receiving the serum in the late stages of the disease died; the three receiving treatment in the earlier stages recovered.

Vigorous measures were at once taken by the authorities. The school was placed under strict quarantine; and a medical officer was established in residence, with a competent staff.

Next day every inmate, except those actually suffering from the disease, was inoculated with Noguchi vaccine, and subsequently all the day scholars were inspected twice daily for six days. None of the latter contracted the disease. The fact that they used the buildings only when the sun was at its hottest may have had some bearing on this.

All of the buildings were fumigated, so far as possible, with two pounds of sulphur to 1,000 cubic feet. It was, however, impossible to make this thorough, as the fumigation had to be done in sections, the inmates, 150 in all, being moved from one building to another as required.

Within five days after this fumigation, seven more cases occurred. During the next seven days there were no further developments, and it was hoped that all the infected mosquitoes had been destroyed, or that the vaccinations were thoroughly preventive or both. Unfortunately, this hope proved ungrounded, as on September 2 (or seven days after the fumigation) two more cases occurred, and another on the following day. It was thus evident that infected mosquitoes were still present. The authorities thereupon determined to take drastic action, which, although unpopular at the time, has since been admitted by all to have been wise.

I cannot do better than quote the description of these measures as reported by Dr. Gann, the principle medical officer.

"It was then realized that the only means of putting an effectual stop to the disease was the removal of all the inmates of the college to a place where no stegomyia existed, and a fumigation of the college and its outbuildings, during their absence, so thorough as to render it practically impossible for any infected mosquito to survive. The college authorities were very much opposed to any such complete removal of all the boys and the staff from the college building in Loyola Park, and it became necessary for the Local Board of Health to serve a notice on them, to the effect that under Public Health Ordinance such a removal would be compulsory.

"The site chosen for the segregation of the inmates of the college was a small island named Sergeant's Cay, situated about twelve miles from Belize, where, after careful inspection by the government medical officers, and by the representative of the United States Public Health Service then in Belize, it was ascertained that no stegomyia mosquitoes were to be found. This Cay had the further advantage of having an ample supply of vat-stored water and four good houses with cooking accommodations.

"The Cay was acquired by the government for the purpose. The housing accommodations were supplemented by the erection of wood-floored tents and a marquee, together with the provision of ample latrine accommodations and cooking facilities. Those preparatons took time, and it was not till September 13 that the boys were removed to Sergeant's Cay. They remained there till the 23rd under the supervision of Dr. Folse, assistant medical officer, who lived on the Cay; and all enjoyed excellent health. No case of yellow fever developed amongst either the boys or the staff. On the 23rd some of the boys returned to their homes, while those who lived in Guatemala and Spanish Honduras were shipped off to those countries, though the boat which took the Honduras boys to Puerto Cortez was refused pratique by the Port Authorities, and they were shipped back to Belize without being allowed to land, or the vessel even being permitted to procure provisions or water.

"Between the 13th and 23rd the college, with its outbuildings, was twice most thoroughly fumigated with sulphur; cracks in the windows and doors were securely pasted over with paper, while all the larger openings were closed by having tarpaulins, ground sheets and blankets nailed over them, so that it would have been impossible for any mosquito within the building to escape. In the open space beneath the main building, and in the extensive verandahs which run all around it, pots of sulphur were burnt before the fumigation proper took place, in order, as far as possible, to drive the mosquitoes haunting these situations to the interior of the buildings, where they would be killed by the fumigation.

"On October 5 Loyola Park was declared to be no longer an infected place, under the Public Health Ordinance, and it was reoccupied. As no further case of yellow fever has occurred there since, it may, I think, be accepted that no infected mosquito escaped the double fumigation, and that the precaution taken, in isolating the whole community for ten days on Sergeant's Cay, and thoroughly fumigating the college during their absence, had been successful, so far as the college was concerned, in ending the epidemic."

The outbreak had thus far proved the value of the Noguchi serum as a curative agent, but left that of the Noguchi vaccine in doubt. The efficacy of the latter, however, appears to me to have been demonstrated by the further history of the outbreak, which later on reached the town.

Immediately after the outbreak occurred at the college, free vaccination for all was instituted at the public hospital; and with a few exceptions that part of the population commonly regarded as non-immune gladly availed themselves of it, but comparatively few of the natives did so. More than 500 were vaccinated, and of this number at least 150 may be regarded as having been newcomers.

After an interval of three weeks, a negro labourer living in the heart of the town was admitted to the hospital on September 27. He gave a history of having been taken ill with fever on the 18th, and of having had complete suppression of urine since the 22nd. Yellow fever was diagnosed, and he was given the Noguchi serum on the tenth day of the disease. He died on the twelfth day of the disease, having had almost complete suppression for seven days, only a few c.c. of a bloody fluid having been drawn off. He had not received a

prophylactic. There were only two more cases in this outbreak, and although neither of them occurred in Belize, yet both of them must have received their infection there.

A young white woman, who resided in Belize for a few months, left the colony for New Orleans on November 5. On the following day she developed fever, which was diagnosed as malaria. When she arrived in New Orleans on the 8th, she had no temperature and was allowed to land. Shortly after landing, she again developed a temperature, which on the 10th was diagnosed as yellow fever. She died almost immediately afterwards and this diagnosis was confirmed at the autopsy on the 11th. This woman was one of the few newcomers who had persistently refused to be vaccinated, being prejudiced against it because she believed that an aged relative had died in Rome after receiving what seemed to be a similar injection for pneumonia.

On October 31 a young man arrived in Belize from Mobile, Alabama. He remained for twelve days and then proceeded to a coast town about forty miles distant. Next day he developed yellow fever. On the fourth day of the disease he received 60 c.c. of Noguchi serum, and made an uneventful recovery.

If it be only a coincidence, it seems a strange one, that the only two whites who contracted the disease in the town had not been vaccinated with this serum, while 100 or 200 who *had* been vaccinated escaped, although they were equally susceptible and equally exposed.

Summary.

The following are significant facts:

Of the seventeen cases occurring at the college, all received the Noguchi serum.

Of these, four were already in their fourth to sixth day. All died.

Of the other thirteen, all received the serum on their first or second day. Only one died.

No cases occurred in the town among those who had been vaccinated. Of the three cases which did take place in the town, one received the serum not until the tenth day and the case ended fatally. Another received it on the morning of the fourth day and recovered. I do not know whether the fatal case in New Orleans received the serum or not; if so, it could not have been before the fifth day.

It is my firm opinion, based on experience gained in the 1905 epidemic, that several more cases would have ended fatally but for the serum treatment; and also more cases would have occurred in the town, had not the anti-yellow fever vaccine of Noguchi been available. In the 1905 outbreak there was a mortality of over twenty per cent. distributed evenly throughout the epidemic; in the 1921 epidemic, the mortality was practically confined to those cases which were treated too late for the serum to be of any benefit. Among those cases that received the serum during the early stages of the disease only one fatality occurred.

The town of Belize, being partly at and partly below sea level, from a sanitary point of view is a hard problem. Most of the low-lying areas are in communication with the sea, and contain either salt or brackish water. This condition, while favourable to a certain species of the mosquito pest, is not much appreciated by either the stegomyia or the anopheles variety. Breeding places for these species, however, are many; (i) the rain-water containers, ranging from vats to barrels and kerosene tins, on which the inhabitants solely depend for their water supply; (ii) the numerous depressions holding fresh water during the wet season; and the empty tins and similar rubbish which accumulate in many of the yards.

Although there exist thoroughly efficient and model laws dealing with mosquito destruction, it is very difficult and irksome to be obliged to continually enforce them, and the town was lulled into a sense of security as a result of its fifteen years immunity from the plague.

Upon the discovery of the outbreak an appeal was made to the Rockefeller Foundation, and the reply was both prompt and effective. In a very short time Dr. E. I. Vaughan and Mr. B. R. Dyer, of the Foundation, arrived with an almost unlimited purse, and with an equally unlimited supply of that energy and tact which is so necessary for the successful and smooth working of all public health measures.

An executive commission was appointed, and an adequate staff enrolled, and an energetic campaign established for the systematic inspection of the town, oiling and screening of water receptacles, and the thorough cleaning of yards. Within a few months these measures were accomplished to such an extent that the mosquito index fell from fifty per cent. to within the five per cent. safety line established by the Foundation. It has remained at that point ever since. I thoroughly agree with Dr. Agramonte that the anti-mosquito work should be continued. I should consider the Noguchi treatent as being of value only in the midst of an actual outbreak.

The Foundation worked with us for a year and accomplished a maximum of work and education with a minimum of friction.

The services of a thoroughly qualified sanitary inspector were then obtained, and both the staff and the system are being efficiently maintained. This is true not only in Belize, but in all the principal towns of the colony, especially those on the seaboard.

It is interesting to note that this sanitary inspector—Mr. J. H. Peach—is gradually persuading the householders to substitute for the costly wire-screening method a system of "fishing" the tanks, with a species of small fish known locally as "Billums." They live well in the tanks, and a couple of them are able to keep any ordinary tank free from mosquitoes. All the public and many private water containers are now stocked with the

fish, and there is still so much demand that the supply is not adequate.

Belize is much in need of extensive reclamation work and a pipe water supply. The latter would be very costly, as no supply by gravity is available.

The town is not wealthy, and up to the present time no rich uncle or fairy godmother has come along; but it is still in hopes that the necessary improvements will be accomplished even if it has to apply to the "well-known uncle" for a loan.

Belize is not unhealthy. It has had only two small outbreaks of yellow fever during the last thirty years. Curiously enough, they occurred at fifteen-year intervals, and each was stamped out in less than six weeks.

Strong sea breezes blow for about eight or nine months in the year, the temperature very rarely reaching ninety degrees. Zymotic diseases, except those of childhood, are practically unknown, and the class commonly known as tropical diseases is comparatively rare. The anti-mosquito campaign is already showing results in the form of reduced hospital admissions for malaria. Europeans live there for thirty to fifty years in the best of health, and like myself, are apparently taking only one serious risk—that of dying of senectus.

Chemo-therapeutic Experiments with Chaulmoogra and Allied Preparations (Otto Schobl, *Philippine Journal of Science*, vol. 25, No. 2, August, 1924).—The aim of the author's experiments was to survey certain organic compounds belonging to various groups with regard to their growth-inhibiting activity toward acid-fast bacilli. Water soluble compounds showed an antiseptic effect, whereas the fat solvents such as benzol, toluol, &c., which have a strong hypnotic effect, were found to be only slightly antiseptic, or not at all. Sodium, copper and nickel salts of fatty acids were found about equally effective, whereas zinc, strontium, lead and uranium salts showed no effect. The double-bond-containing compounds all showed antiseptic effect, the double bond being more effective on the side-chain than on the ring in aromatic compounds. Unsaturated alcohols showed an antiseptic effect, particularly when containing the phenyl group which proved to be the most powerful toxic group. High alcohols approaching waves show no effect. Secondary alcohols were equally or less effective than primary alcohols. Hydroxy compounds are highly antiseptic toward acid-fast organisms as they are toward other bacteria. The antiseptic effect of phenols increases with the number of hydroxyl groups, the position of these groups being of importance, as the ortho-compounds are more antiseptic than the para or meta compounds. Alkylation on the ring increases the antiseptic effect of phenols, whereas alkylation on the OH group of polyhydroxyphenols has no noteworthy effect, provided at least one hydroxyl is preserved.

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A WHITE AUSTRALIA: IS IT A POSSIBILITY?

By SYDNEY J. SKERTCHLEY, J.P.

(*Continued from page* 17.)

CHAPTER VI.

The Story of the Fair Whites.

(77) The original home of the Fair Whites, is along the Baltic shores, eastwards to the Vistula, westwards to the Rhine. We will now trace a few

of the migrations and learn if these almost unconquerable, seldom vanquished, receptive-minded people could hold by virile power what their swords won by personal valour. They were banded into many tribes, but their blood was one, and to this day we speak proudly of them as the dominant and dominating Anglo-Saxon or Teutonic race. Every one of the British colonies is due to their enterprise, and the great Republic of the United States of America (which curiously never adopted a name for itself) prides itself upon its Anglo-Saxon lineage, and shares with us the storied glories of our Valhallas —Westminster Abbey and St. Paul's Cathedral. We shall devote a special section to the consideration of their power to hold their own on what they now call their native soil.

(78) It was always a wandering, always a colonizing race, and in this last particular has surpassed all rivals. The old Viking blood that runs in (some of) our veins boils up still, ever and anon, and sends us flying to every spot on earth not covered with everlasting snow and ice.

(79) When the first migration of the Fair Whites took place we cannot stop to discuss. It must suffice us to note that the early Roman and Greek belonged to them, though no trace of these fair-haired, blue-eyed heroes is left in Italy or Hellas. We will confine ourselves to historical evidence, and begin as late as the history of Rome.

(80) Within the first three centuries of our era three confederations of Fair White barbarians harassed the Roman Empire. They are generally known as the Goths, the Franks, and the Alemanni, each an amalgamation of tribes, not always the same in composition.

(81) Now comes a curiously glossed-over fact. The Rhine, against which the Roman legions always spent their strength in vain, never proved an obstacle to the southward march of the strenuous Fair Whites. History, as I read it, on the other hand presents no case of the southern Dark Whites successfully crossing that legend-haunted frontier. "Die Wacht am Rhein" is more than an outpost ditty to the northron; it is the embodiment in ringing verse and stirring strain of a fact old as the human race itself. Who has forgotten 1870? Who that knows this frontier land can forget the miles on miles of strategic railway lines and sidings that have spun their iron web—a ghastly gossamer—along the picturesque route which is the touring ground of nations, as it is their battle-field? No race on earth has such a heritage of victory as the Fair Whites—they are unconquered and unconquerable.

(82) Eastward and southward the Rhine and the greater Danube (especially in its upper course) thread their way through the borderland across which the Fair Whites surged for centuries. But their real home is where the cold winds of the North Sea and the Baltic bite and stir the blood and make exercise exhilarating. In the warmer south muscle grows lax. It is this blood, born of the north wind, that has given, and is giving still, the stimulus that has driven the northerner to the uttermost parts of the earth; and far beyond the confines of his native soil his name is stamped upon the map.

(83) Lombardy preserves the name of the Langobardii, whose kingdom lasted well into the eighth century, but whose blood has died save where, here and there, one comes across the red-gold hair beloved of the Venetian painters. Venetia itself preserves the name of a dead race. France recalls the Franks, the Freemen of the north, but France is no more Frankish than Normandy is Norman. Burgundy still exults in foreign blood, but it is the red blood of the grape ripening on the sunny slopes of the Côte d'Or, which overlook the tulip-flecked meadows of the swift Rhone, and not the blood of the conquering Burgundian. The Antonines brought the vine, but Roman blood grew thin, and now one has to seek the even sturdier Burgundian of the north in half-forgotten graveyards. Andalusia is Vandalusia no more, and in Galatia we find no Gauls.

(84) But what of the great barbarians who have failed even to impress their names upon the map? The Alemanni were a race whose home was on the Upper Rhine. They were enemies alike to the Roman and the Gaul. Caracalla, whose baths we still visit on the Via Appia of old Rome, took the name of Alemannicus after a victory over them. They spread from the Rhine to the Danube. Julian broke their power at Strassburg. Would you find their descendants they must be sought in scattered parts of Suabia, Alsace, and Switzerland. Yet so powerful were they that to this day the French call all Germans by the name Allemand.

(85) The Heruli, early in our era, had established themselves on the northern shores of the Black Sea. In the fifth century they allied themselves with Attila, the Hun, and on his overthrow established a confederacy on the Danube, their king, Odoacer, assisting in the overthrow of the Western Empire. Within a hundred years they are dispersed, some fleeing north to their Scandinavian home, some south across the Danube. Another century, and history and anthropology know them no more.

(86) But the greatest of the Fair Whites were the Goths and Vandals. Their very names have become but a byword and reproach, though they alone enjoy the proud distinction of being conquerors of Imperial Rome; to them alone the Cæsars had to bow, and yet, of all their conquests, from the Crimea to Spain and Africa, not a trace remains save the one mutilated name—Andalusia. Even in the north the Swedish Gothland is the record of the Getae and not of the Goths. The historian Freeman is himself struck with this, and writes: "No Teutonic people fills so great a place in the political and military history of the Fourth, Fifth, and Sixth Centuries, and no Teutonic people has left behind us such early remains of a written native literature. The real greatness of the Goths quite accounts for the many vague uses of the Gothic name. Alike in scorn and in honour, the Goths have been, not unreasonably, taken as the representatives of the entire Teutonic race. The wonderful thing is that a people who have taken so great a part for several ages should have wholly

passed away. The Goths have not for many ages existed anywhere as a distinct nation, nor have they given an abiding name to any part of Europe. Franks, Angles, Saxons, Burgundians, Frisians, Thuringians, Lombards, perhaps Vandals, are all visible on the modern map. So several parts of Europe have at different times been known as Gothia; but the name was never borne by any large country, and it has nowhere lasted down to modern times."

(87) Take the case of the Vandals. They were closely allied to the Goths and in the first century were located in Brandenberg and Pomerania. They spread southward to the Bohemian border in the next century. In the fourth century they settled in Pannonia, and the fifth finds them across the Pyrenees, settled in Spain in two divisions—the Asdingians in Galicia, the Silingians in Andalusia. In 428-9, at the request of Boniface, ruler of the province of Africa, they sail for those romantic shores, and under their warrior king, Genseric, soon became masters instead of mercenaries. St. Augustine, eloquent father of our Church, advised Boniface to call these fair-haired invincibles to his aid, and now they are thundering at the gates of Hippo as the saint lies dying. Soon Carthage itself shall fall, and for a century serve a Vandal king. By the year 440 Genseric, from his Vandal kingdom of Africa, is sweeping the Mediterranean as precursor of the Barbary pirate of yesterday. Five years after he enters Rome and loots it as leisurely as if he were selecting stock in a warehouse, and the spoils of the Temple of Jerusalem, won by Titus, fall into Genseric's hands and are henceforward lost to history. Can triumph be more triumphant? Yet in less than a hundred years the Vandal is but a name; he had overshot the anthropologic boundary beyond which the Fair White may not step and live.

(88) Stranger still, if that be possible, is the history of the Goths. They seem to appear in history as the Guttones or Gothones, on the south Baltic shores. They spread southwards, and just as in England the Saxons became divided into East-Saxons and West-Saxons, so the Goths became Ostro (Eastern) and *Visi* (Western) Goths. But ere the great split happened the Goth had become a factor in the story of the Roman Empire.

(89) In the third century of our era the Goth had travelled south to the Danube and established himself pretty firmly in Dacia, and was already harassing the borders of the empire. It is even said that the Emperor Maxamin was himself a Goth, though perhaps this is a confusion of the terms Getae and Gothi. In the middle of the century they defeat the Romans, having crossed the Danube and ravaged Moesia. They spread themselves further east, founded a settlement in the Crimea, and ravaged all the coasts of the Black Sea. Passing through the Dardanelles they swept over Greece, not even Athens being able to withstand their onslaught. So important was a victory over them deemed that Claudius, the hero of Natissus, in Dardania, assumed the cognomen of Gothicus, just as Caracalla had taken that of Alemannicus. The Gothic defeat was in 269, but it was only a temporary check, and five years after the Romans permanently withdrew their legions south of the Danube, and the Goths claimed dominion from the Danube to the Baltic. They were the peers of Rome already, soon they were to be her overlords.

(90) This was the high water of the prosperity of the Goths in eastern Europe. They were on foreign soil, and though they had hurled the legions back, they in turn were stunned beyond recovery by the impact of the Huns, whose story we have already sketched. Many of the Goths remained in the Danubian provinces, retaining their autonomy under their own chiefs, but with the Huns as suzerains, whose banners they were bound to follow in war.

(91) Then a great migration southwards ensued. The Goths split into the Ostrogoth and the Visigoth. Received with cordiality into Italy they settled in the north, but friction soon arose, and finally, in 395, the Ostrogoths became independent, under Alaric, who ravages Greece and sacks Rome itself. This Gothic kingdom lasted till 553. If now you would seek Gothic blood in northern Italy you must look at golden-haired Alexander the Great, as painted by Paul Veronese,[1] or perchance, as I did once, find it in a flower-girl on the Rialto,

> Shylock's bridge with houses on it,
> Where they kept the Carnival.

As in Europe, so in Asia; neither in the Ukraine nor in that Tauric Chersonese we now call the Crimea, is Gothic blood to be found, though Gothic speech still lingered on for centuries, and now it, too, is forgotten.

(92) Turn we next to the Visigoths, the Goths of the west, the conquerors and rulers of Gaul and Spain. So powerful were the Goths that Ataulf, the brother-in-law and successor of Alaric, had married Placidia, the daughter of the Emperor Theodosius, and had not their only son (named Theodosius after his grandfather) died young, a dynasty might have arisen uniting the Gothic and Roman claims. Ataulf at first meditated the entire overthrow of Rome, and making and calling the empire Gothia, but realizing that stable government depended upon Roman law, he, with his hosts, went westward into Gaul to restore the Roman power threatened by Frank and Burgundian, Fair Whites like himself. This was the beginning of the kingdom of the Visigoths.

(93) As the Roman power waned the Visigothic waxed strong, and from receiving Gaulish territory as recompense for services rendered to the empire, they speedily assumed the purple for themselves, and in 414 the Visigothic kingdom of Toulouse was established. By 475 all Gaul west of the Rhone acknowledged their sovereignty, and the western Roman empire itself lasted but two years longer. But another Fair White star was rising—that of the Franks, and Clovis, their king, after slaying Alaric near Poictiers, drives the Goths south of the Pyrenees, and Gaul becomes France.

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[1] Alexander and the Persian queen, &c., are said to be portraits of the Pisani family.

(94) Yet the Visigoths were not subdued, and in Spain they founded a greater kingdom still, expelling the Romans finally in 468. Apparently secure they ruled the great Iberian peninsula. But the doom of the Fair White was impending, and 300 years after their coming they fell before the scimitar of the Saracen, and not even their name is left to show the swarthy Spaniard he ever bowed the knee to the blue-eyed stranger from the north.

(95) Here, reluctantly, one must close the story of the Fair Whites. It has only been sketched in barest outline—could it be filled in it would be but piling Pelion on Ossa, for surely the deduction is startlingly apparent! Could any better chance be offered to man than Vandal and Goth had in Europe? Practically every foot of European soil has felt their conquering footfall—their dominion overlapped Europe into the Crimea on the east and Africa in the south—they not only shook but destroyed imperial Rome—and yet! What their swords won they kept, and kept it for centuries. Still the stern anthropologic law held good—thus far shalt thou come and no further. Truly the experiment has been tried often enough, over wide enough areas, over sufficient time. And to-day if you seek the living blood you must hie to those Baltic shores that engendered it, for elsewhere the Vandal and the Goth are but dust.

Annotations.

Death from Tick Paralysis in Human Beings (E. W. Ferguson, *Medical Journal of Australia*, October 4, 1924).—The cases on record of paralysis in human beings as the result of tick infestation in the eastern coastal regions of Australia are few, although it is a well recognized affection. The tick responsible for paralysis and death in human beings is the common scrub tick *Ixodes holocyclus*, Neumann. The female tick alone appears to be toxic and symptoms do not supervene until the tick has been attached for at least three or four days and has reached a certain stage of repletion. It is commonly believed that the paralysis is due to a toxin secreted by the tick. Five cases are reported, in four of which the legs appeared to be most affected.

The Local Effects produced in the Tissues by Intramuscular Injections (H. W. Acton and R. N. Chopra, *Indian Journal of Medical Research*, October, 1924).—The three drugs antimony, emetine and quinine, when injected intramuscularly for the treatment of kala-azar, amœbiasis and malaria respectively, all produce local effects on the tissues. Antimony causes œdema, irritation and pain; emetine, petechial hæmorrhages and bruising; and quinine, œdema and necrosis. Quinine bihydrochloride exerts its effects on the tissues in two ways: (*a*) The liberation of the acid radicle causes œdema, irritation and pain: (*b*) the base, acting as a protoplasmic poison, causes death of the surrounding tissues. Cinchonine hydrochloride, when injected into the tissues, produces necrosis and œdema, and is the weakest alkaloid therapeutically. The salts of the four main alkaloids of cinchona bark all cause œdema, irritation and necrosis of the tissues. The injection of these alkaloidal salts into the muscles of man should be considered as malpraxis, as this tissue is unable to live in the presence of these bases at a high concentration, viz., 1-2000, and there is also a slight danger of tetanus. Tetanus following an intramuscular injection of quinine is due to the introduction of tetanus spores owing to imperfect sterilization; the necrosed area forms a suitable nidus. There is only one method of administering the cinchona alkaloids and that is by the mouth. Very rarely in grave cases, e.g., cerebral malaria, when an immediate action is required, quinine base should be injected intravenously.

Jute Dermatitis (Dagmar F. Curjel and Hugh W. Acton, *Indian Journal of Medical Research*, October, 1924).—Jute dermatitis is a non-suppurative folliculitis, caused by the mechanical blocking of the sebaceous gland orifices by plugs of the unexfoliated stratum corneum. The mineral oil used for softening the jute does not irritate the skin, but protects the skin from water and so increases the accumulation of the stratum corneum. The disease is more commonly seen amongst the lower class Hindus, who have generally a coarser skin and do not use much soap, &c., for washing. The disease has escaped adequate description as a trade dermatitis amongst workers in the tropics, for the eruptions are not associated with subjective symptoms and occur in a class who are indifferent to their personal appearance.

The Preparation of Hydnocarpus Esters and their Use in Leprosy (E. Muir, *Indian Journal of Medical Research*, October 1924).—Hydnocarpus oil is derived chiefly from *Hydnocarpus wightiana*, which belongs to the same family as *Taraktogenos kurzii*, from which chaulmoogra oil is derived. *Hydnocarpus wightiana* has many advantages over *Taraktogenos kurzii*, the chief being that it is more easily accessible and can be cultivated in countries where it is not indigenous. In common with the oils derived from other trees of the same family, hydnocarpus oil contains hydnocarpus acid, chaulmoogric acid and other fatty acids of the chaulmoogric series. A description is given of the preparation of esters, which is extremely simple. The esters should either be bottled in glass-stoppered bottles or filled into ampoules of suitable size. The latter are safest for the treatment of single cases, but the glass-stoppered bottles are more convenient and cheap for large numbers of cases. The preparation can be administered either intravenously or subcutaneously. To obtain successful results in treatment care should be taken that injection is made into loose subcutaneous tissue. Esters of hydnocarpus oil mixed with an equal quantity of pure olive oil can be injected in doses ranging from 0·5 c.c. to 10 c.c. Thymol added to hydnocarpus oil enhances its therapeutic value. Of course suitable cases must be chosen for treatment, not those where permanent lesions already exist.

The Mechanism of Immunity against Malaria in Communities living under Hyper-endemic Conditions (S. R. Christophers, *Indian Journal Medical Research*, October, 1924).—In endemic malaria there is a regular co-ordinated sequence of events connected with the infection rate, numerical value of the infections, the spleen rate, the average size of the spleen and the numerical prevalence of the different degrees of enlargement of this organ. A proper numerical and precise study of the intercorrelated phenomena constitutes a science or study that deals with the malaria of communities, and is more especially concerned with conditions that necessitate the investigation of the effects of overlap and superposition of infections in malaria, conditions that are among the most important in the science of malaria, since they are normal to a large proportion of the human race living in the subtropical and tropical zones, and are especially those that are involved in the malaria of tropical population. In the particular community studied, the spleen rate among the children was approximately 70 per cent., and that among the adults 10 per cent. The parasite infection rate in the children was of the usual high character, being 85 per cent. The details of the malarial happenings in this community formed the subject of the present investigation. They confirm the results of Schnuffer for the hyperendemic communities in Sumatra and further extend precise methods of observation in such investigations. All the community are probably continuously infected.

Studies in Dracontiasis. Part IV. The Clinical Picture. An Analysis of 140 Cases (N. Hamilton Fairley, *Indian Journal of Medical Research*, October, 1924).—Generalized urticaria was observed in fifty-four out of 138 patients (39 per cent.) investigated during the present seasonal attack. A marked individual predisposition to it was found in certain cases. Attacks during a previous season did not confer immunity to urticarial eruptions in subsequent years, but it was distinctly rare to find a history of more than one bout of urticaria during any given season even though many worms were present. Perhaps *temporary* desensitization to helminthic toxic substances supervenes on the urticarial syndrome. The onset of urticaria was generally at night, and in forty-six out of fifty cases it appeared before the blister or other localizing features were noted. In a majority of cases its duration was under twenty-four hours. Other signs and symptoms were frequently associated with the urticarial eruptions, and varied according to whichever system was dominantly affected. Gastro-intestinal features including nausea, vomiting, hiccough and diarrhœa. Cardio-vascular involvement was indicated by giddiness, syncopal attacks and other symptoms. Dyspnœa was a prominent feature in certain cases. The pulmonary dyspnœa and other systemic manifestations were immediately relieved by the subcutaneous injections of adrenalin. The local lesions caused by *Dracunculus medinensis*, including the blister and the resulting ulcer, are described. Death of the worm prior to pointing may be followed by calcification *in situ* or the formation of a deep sterile abscess caused by liberated embryos. The distribution of the local lesions was recorded in 252 instances. The lower extremities were implicated on 218 occasions, the upper extremities in fourteen, the trunk in eleven, the buttock in five, and the scrotum in four. All complications (except calcification) were dependent on secondary bacterial infection. There were fifty-five cases of acute and subacute abscess, seventeen of cellulitis, while many showed associated tender glandular enlargements or even buboes. Instances of synovitis, tenosynovitis, epididymo-orchitis, acute arthritis and permanent deformaties due to fibrous ankylosis of joints or contraction of tendons were observed in the series. The value of the hæmatological data was curtailed by the fact that in most instances of dracontiasis there was associated helminthiasis.

Studies in Dracontiasis. Part V. Observations and Reflections on Intravenous Medication with Special Reference to Tartar Emetic (N. Hamilton Fairley, *Indian Journal of Medical Research*, October, 1924).—The majority of guinea-worm cases did not present themselves for clinical examination until the blister had ruptured and bacterial contamination of the ulcer surface ensued. In 43·7 per cent. septic complications were already established. In this group of cases mechanical extraction of the parasite is necessary whether the worm is living or dead, and it is the writer's contention that delay by medical treatment under these circumstances is inadvisable. Specific drug therapy, if lethal to the parasite, would be of real value in the minority of cases seen prior to rupture of the blister. Under these circumstances death of *Dracunculus medinensis* is followed by its absorption *in situ*. In a carefully selected and controlled group of early cases tartar emetic was found neither to exert lethal action on the female worm and its embyros nor *per se* to modify the clinical course of the disease. Its use in this clinic has been entirely abandoned.

Further Observations on Latent Dysentery. The Practical Value of the Discovery of Latent Dysentery Cases as a Method of Dysentery Control (J. Cunningham and K. V. Krishnan, *Indian Journal of Medical Research*, October, 1924).—An account of three investigations in which the macroscopic method of detecting latent dysentery cases has been utilized as a means of controlling dysentery is given. The first of these was carried out by Lieutenant-Colonel Bateman, R.A.M.C., in a military community, the second and third by the authors in the Bellary and Cannanore jails respectively. The dysentery index in each of these series was found to be as follows: Colonel Bateman's series, 27·0; Bellary series, 30·9; Cannanore series, 27·6. The detection and segregation of the cases of latent dysentery was immediately followed by a rapid and continuous diminution in the dysentery rates in each case. In the Bellary and Cannanore series 92·5 per cent. and 94·5 per cent. respectively of the subsequent admissions into the

hospital for dysentery were divided from the latent dysentery groups which had been previously isolated. Forty-eight out of 184 men working in the cook-house in Bellary and fifteen out of fifty cooks in Cannanore were discovered to be suffering from latent dysentery. The improvement in the conditions in these communities was due chiefly to the detection and segregation of the latent dysentery cases from the normal population. The detection and isolation of latent dysentery cases is thus of the greatest importance as a practical measure of dysentery control. The systematic macroscopic method of examining the stools is the best and surest method of discovering these cases in that it is rapid, cheap, requires no special skill or apparatus, is eminently efficient, and can be applied to large communities.

A Report on Plague Investigations in Egypt (G. F. Petrie, R. E. Todd, R. Skander and F. Hilmy, *Journal of Hygiene*, November, 1924).—The summary of this paper is as follows. The extent of the disease at any moment in the epidemic period is determined not by the strictly contemporaneous weather conditions, but by those which existed four to six weeks previously. The interval is attributable to the effect of atmospheric conditions on the various stages of development of the rat flea (*X. cheopis*). When this lag period is taken into account, there is found to be an optimum range of temperature from 20° C. to 25° C., and of vapour pressure deficiency from 1 to 10 millibars for plague prevalence; these too are the optimum limits for flea development. The degree in which the climate of a locality approximates to the optimum determines to a definite extent the normal character, whether mild or severe, of its plague history. In maritime localities the atmospheric temperature is a more important factor in regulating the prevalence of the disease than the vapour pressure deficiency. In places with a hot dry climate the rise of the epidemic is correlated with the temperature variations; a high prevailing temperature or excessive dryness of the air (vapour pressure deficiency) or a combination of these hastens its decline by increasing the mortality in the infected part of the rat-flea population, and thus restricting the transference of the infection. In certain localities, when the temperature is favourable, a dry atmosphere with a vapour pressure deficiency above the optimum limit is able by itself to check the spread of the disease. In the dissection of the climatic factors associated with plague the diurnal temperature variations deserve attention. The gradually increasing delay in the onset of epidemic plague from south to north of Egypt is correlated with the seasonal variations in the climate throughout the country. The analysis leading to this conclusion indicates that, in agreement with the data from India and elsewhere, the seasonal prevalence of human plague in Egypt, as deduced from the massed statistics, is dependent upon the factors governing the prevalence of rat plague, and, in particular, the climatic factors that influence the life-history of the rat-flea (*X. cheopis*).

Abstract.

REPORT OF HÆMOGLOBINURIC FEVER IN THE CANAL ZONE, ITS ÆTIOLOGY AND TREATMENT.[1]

THE history of hæmoglobinuric fever proves that the symptomatology of the disease was recognized and recorded prior to the time when the malady was distinguished either as an entity or as a symptom-complex of malaria. There is no proof that blackwater fever has spread from one country to another, or from one part of a country to another, as have kala-azar, yellow fever and sleepy sickness. On the contrary, the disease invariably manifests itself when certain conditions relative to the epidemiology of malaria, and to that of no other disease, are present. These conditions are:

(1) The presence of a population non-immune against malaria.

(2) The prevalence of malaria in such quantity as to produce an almost continuous infection in this population.

(3) A large proportion of æstivo-autumnal malaria; because the amount of blackwater fever is in direct proportion to to the intensity of this variety.

(4) The neglect of prompt and continued administration of quinine, especially in primary attacks, to persons non-immune against malaria.

In every locality without exception where these conditions obtain, hæmoglobinuric fever is found.

The conditions may vary from time to time in the same or in different localities, with a corresponding increase or decrease in the amount of hæmoglobinuric fever. They are present in restricted areas and absent from those contiguous. When any condition varies, hæmoglobinuric fevers vary in proportion. In this respect the malady differs from every infectious disease other than malaria, for it does not enter a hitherto non-malarial district except by the introduction of æstivo-autumnal malaria; when this malaria becomes prevalent in a region formerly free, blackwater fever follows in proportion to the intensity of malaria and the capacity of the population to acquire immunity. Also, æstivo-autumnal malaria may obtain very extensively among children when in places where the adult population, by reason of continued attacks in childhood, has acquired immunity. If non-immunes do not enter such places, or if, after their entrance, prompt prophylactic and therapeutical measures are instituted against malaria, blackwater fever does not prevail.

These propositions are supported by positive evidence and do not admit of controversy. Every statement made in support of them has concrete facts and the witness of authoritative observers as its basis. The conditions necessary for the generation of hæmoglobinuric fever explain clearly why the disease is absent from places where it once prevailed, or is

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[1] Abstracted from W. E. DEEKS and W. M. JAMES, A Report on Hæmoglobinuric Fever, Isthmian Canal Commission.

present in those from which it was formerly absent; why it obtains in certain areas only in a malaria-infected district; and why in restricted localities, or even in certain houses, the malady may present itself, while those adjacent are free.

Although the evidence associating hæmoglobinuric fever with the presence of malarial parasites is circumstantial, since it relies in great part on the skill and experience of observers, it is none the less strong and authoritative, in actuality far more so than that which implies a lack of such association. Notwithstanding the reported absence in isolated instances of proof of malarial infection in blackwater fever during life or at autopsy, the connection between the two is not materially affected thereby, for when all circumstances of the relationship are considered in their entirety, the dependency of the latter upon the former is manifested to an extent unparalleled in the etiology of infectious diseases. When to the epidemiological evidence of this relationship is added these proofs, that in no other malady is malarial infection so constantly present; that in malarious countries other diseases fail to show even an approximate amount of such infection; that mechanical and therapeutical measures instituted against malaria are equally efficient against hæmoglobinuric fever; that prompt and efficient treatment against the one, no matter how greatly it obtains, is successful also in reducing the prevalence of the other; either the truth of the relationship as asserted must be admitted, or the existence of an organism dependent upon the conditions enumerated must be assumed. Such an assumption is not supported in biology, either by analogy or fact, unless some vague conjecture of an improbable symbiosis be so included.

In our opinion it is better to describe hæmoglobinuric fever as Marchiafava and Bignami have done, as "a syndrome which is encountered not rarely, especially in hot climates, in the course of a malarial infection." For, although medical usage may sanction in some instances the classification of different conditions dependent upon the same etiological factor as distinctive "diseases," there is no need for such application to the description of the hæmoglobinuria and associated symptoms that "occur in the course of a malarial infection."

Since it is not possible to predicate the amount of infection that results in the determination of any of the other malarial syndromes otherwise than to say that they occur in proportion to the intensity of malaria, it is illogical to assert, as some have done, that blackwater fever should invariably follow when a certain degree of personal malarial infection has been attained. One might as well say that every infection with *Bacillus tuberculosis* is followed by the same symptoms, or that meningitis ensues when a certain number of the diplococci of pneumonia are present.

We know that when such organisms are localized in certain parts of the body definite symptoms follow, and we believe that under certain conditions the toxins of malaria poison produce hæmolysis; but why some persons are thus acted upon while others with equal amounts of infection are not, is a problem that still awaits solution, nor does our lack of knowledge in this respect affect our cognizance of the primary cause. The primary cause in hæmoglobinuric fever is either prior or coincident malaria, or both; the immediate cause is sometimes the administration of quinine, but this never acts unless the primary cause has been present. With this knowledge we are able to treat the syndrome intelligently and often to prevent occurrence by the removal of the primary cause and by sending away from the source of infection those who, since by reason of personal idiosyncrasy they cannot take quinine at any time without the production of blackwater fever, should not remain in a malarious country.

Current Literature.

ANNALES DE LA SOCIETE BELGE DE MEDECINE TROPICALE.

Tome IV, No. 2, November, 1924.

A Case of Creeping Pseudomyasis at Boma (A. Fornara).—This is apparently the first case reported in Boma. A boy of one year was brought to the hospital with a cutaneous lesion on the left leg; it began a month previously with nocturnal itching. The lesion began on the dorsal region of the foot, continued round the external side of the leg, across the sole, and along the internal side of the leg up to the ankle and up the leg. A circle was traced around the lesion with nitrate of silver, which immediately changed the direction of its course. Curettage and examination revealed no parasite, and the case was diagnosed as creeping pseudomyasis, or "oerbis of the ouolofs." After curettage and dressing with alcohol the lesion rapidly healed; the nitrate of silver possibly contributed to the cure.

Treatment of Yaws by Dermatol (J. Miguens).—Fourteen children suffering from yaws, ages between two and eight years, were treated by the author. Three were treated with neosalvarsan and the rest with dermatol (oil suspension of sous-gallate of bismuth), intramuscular injections. The results obtained with dermatol are as favourable as those obtained with the arsenics. The action of dermatol is very rapid; the product is not expensive, it is easy to use, does not cause pain, and is within easy reach of every medical man. In some cases the lesions were of long duration and had not been previously treated. The preparation used was dermatol powder mixed with olive oil, previously washed in alcohol; as soon as it was taken out of the bain-marie (boiling), boiled filtered water was then added. Put into a corked bottle, it is ready for use several days afterwards. It can also be used without the addition of water, and perhaps is better tolerated, if the bottle is shaken before putting in the syringe.

The Pathology of the Natives of the Region of Lokandu (M. Kadaner).—During the author's two

years' sojourn at Lokandu nearly all the maladies met with in Europe have been treated by him. The natives have not much faith in white doctors, but with careful management, and after seeing the good results in others, they readily come for treatment. Macular leprosy is to be found in four to five per cent. of the population; it is known under the name "Bukoma." Tubercular leprosy is rare (half to one per cent.). Injections of atoxyl-emetic have given good results in the treatment of this disease. Yaws is very common and nearly every black has had it at some time or another. 914 is the best remedy for yaws. Bismuth has also given good results, but can only be given intramuscularly. Trypanosomiasis exists along the river from Kindu to Ponthierville, in about one per cent. of the population. The natives willingly undergo ganglionic puncture and injections in this district. Syphilis is very common, especially along the river, but nervous symptoms are less frequent than in Europeans. Small-pox is rare, especially since vaccination (*largomanu*) has been practised. About forty cases of amœbic dysentery have been treated in the two years. Helminthiasis is frequent among the blacks of this region, and malaria also. Phagedenic ulcer is widely spread; goitre is found in certain parts. Tuberculosis in the interior part of the country is rare.

Some Observations on Pneumonia in the Black Race (M. Kadaner).—Lokandu is a military centre where pneumonia among the black race is very common. Most of the recruits are affected during the first few months after their arrival. Some races are more susceptible to the disease than others. The cause is attributed to the change of life and food, and the men's coming into contact with other races for the first time. The first symptom is simply high fever, the local symptoms not appearing till after the second or third day. Symptomatic treatment is generally sufficient. Complications are sometimes observed.

A Hymenoptera Bethylide which stings Man in the Habitations of the Congo (J. Bequaert).—An insect exists in the Tropics, which frequently stings man, and which has been defined as a female hymenoptera without wings, with all the characters of the genus *Sclerodermus* Klug (*Scleroderma* Westwood). The total length of the insect varies from 2 to 3·2 centimetres. They live on the larvæ of *Coleoptera xylophagus* found in books and furniture.

Bronchomycosis due to Sterigmatocystis in Urandi (G. Mattlet).—Five cases of pulmonary affection have been met with due to parasites of the genus sterigmatocystis, which can be divided into two series; those in which the parasite causes benign symptoms and those in which the parasite produces grave symptoms resembling those of pulmonary tuberculosis. Potassium of iodine associated with terebinth or with guaiacol or emetine have given good results.

Contributions to the Study of Geographical Distribution of the Glossinæ (G. Trolli).—During investigations on sleeping sickness of 1908 and 1909 along the River Congo and its tributaries, numerous glossinæ were met with, nearly all being *palpalis*. In 1912 and 1913 investigations in Katanga showed *G. morsitans* present almost everywhere, and *G. palpalis* was entirely absent; other species existing in these parts are described.

"Bayer 205" in the Treatment of Human Trypanosomiasis (F. Van Den Branden and L. Van Hoof).—In man Bayer 205 has a strong trypanocidal action, which, however, is slow. The blood sterilization is more rapid in patients injected intravenously than in those injected intramuscularly or subcutaneously. Bayer 205 and atoxyl do not cure trypanosomiasis once it has reached the second stage; clinical benefit can be obtained more by the latter than the former. The number of deaths recorded in the second stage in sixteen months is forty-eight per cent. Bayer 205 injected intrarachidianly in doses from 0·05 grm. may cause grave accidents, and in doses from 0·30 grm. mortal accidents. Duration of the sterilization of the blood after a single dose of one grm. may be very long. Sterilization is also of long duration in patients treated in the second period of the disease. A cutaneous eruption has been noticed after treatment, similar to urticarial plaques, and a herpetiform eruption on the lips; renal irritation has also been observed, which, in some cases ends with nephritis.

Medical News.

THE UNIVERSITY OF LIVERPOOL.

EXAMINATION LIST.

December, 1924.

Faculty of Medicine.

Diploma in Tropical Medicine.—H. S. Bilimoria, M.B., B.S.; B. L. Davis, M.B., Ch.B.; C. B. Jennings, M.B., B.Ch., B.A.O.; S. W. S. Lee, M.B., B.Ch., B.A.O.; G. Macdonald, M.B., Ch.B.; J. M. Mitchell, M.B., Ch.B.; D. U. Owen, M.B., Ch.B.; Beryl Palmer-Jones, M.B., B.S.; E. J. Sankeralli, M.B., B.Ch., B.A.O.; H. Singh, M.B., B.S.

Recommended for the Alan H. Milne medal: Dr. B. L. Davis.

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THE JOURNAL OF

Tropical Medicine and Hygiene

FEBRUARY 2, 1925.

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THE CANCER PROBLEM.

ON June 2, 1924, we published a paper on the Elucidation of Cancer by Dr. Louis Westenra Sambon, a remarkable paper, the result of a few weeks' field-work in certain districts of Romagna (Italy) greatly afflicted by the fearful tumoral disease. That paper was much appreciated, not only here, but even more so abroad, witness that it was translated into French by Dr. Nègre of the Pasteur Institute, Paris.

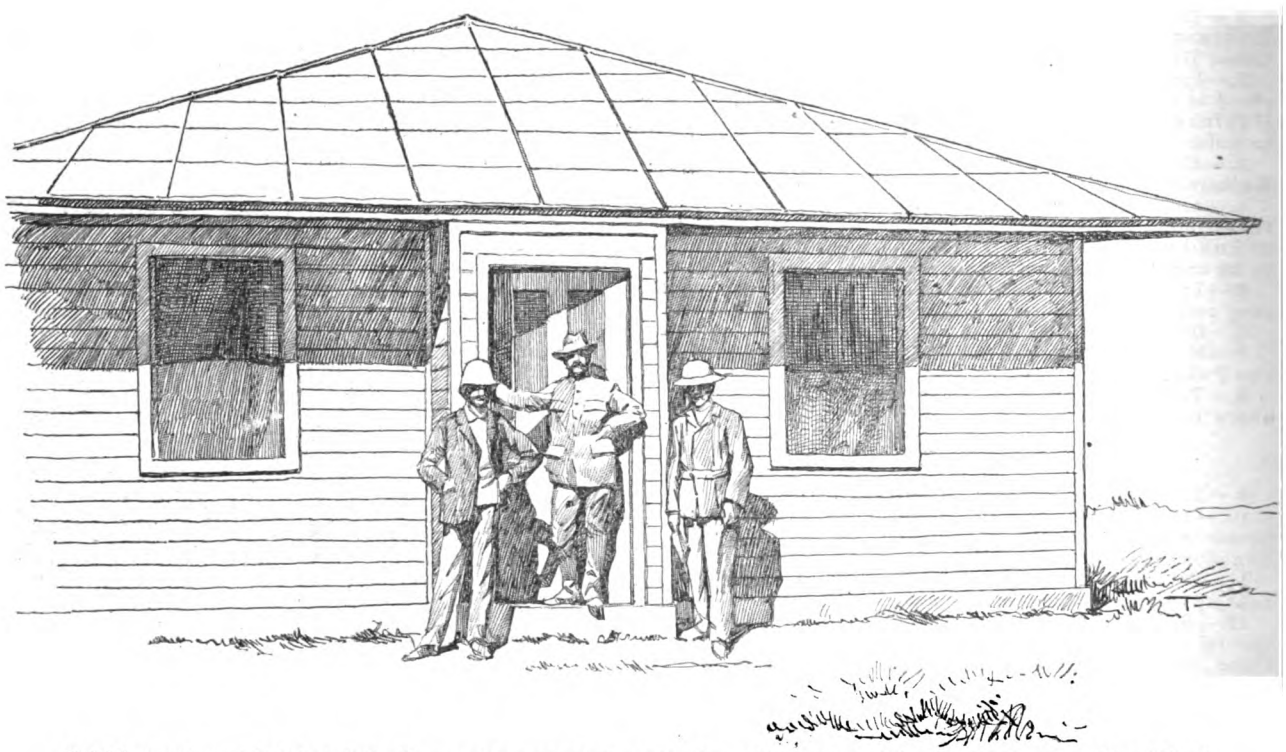
To-day, after a few months only, we publish a second, larger, more imposing report by the same investigator, the outcome of subsequent researches made in Iceland and Italy last summer and autumn. This report, given in the shape of a lecture, read on December 10 last at the Pasteur Institute, Paris, laden, as it is, with important, irrefutable documents, stands as a finger-post indicating the straight road to the elucidation of cancer. After reading it, one cannot fail to see that Sambon has overthrown all the theories, speculations and vagaries that barred the way to an understanding of the cancer problem. The clear, incisive views stated in his essay strike one forcibly. We understand and sense that cancer is an infective disease caused by some intracellular micro-organism which attacks tissues of low or lowered resistance, favoured by the agency of diverse factors among which parasitic worms seem to play the major part and are themselves subject to intermediary hosts which determine the peculiar distribution of the malady. The epidemiology of cancer, hitherto unsuspected, emerges clear as a sunlit landscape out of the fog of our ignorance, as we read Sambon's report of his travels and study the charts and maps with which it is illustrated. One does not know what to admire more, whether his comprehension of epidemiological facts, or his parasitological knowledge, the beauty of his narrative, touched up here and there with short word-pictures which bring the very places before one's eye, or his logical, far-seeing, penetrating mind. But above all stand out two important facts: (1) cancer is a parasitic disease, (2) its control is within our reach.

It is fortunate that, at last, our foremost epidemiologist has taken up the question of cancer and placed it where it should have been long ago.

An epidemiologist is a quantity but little known amongst us. Few men in the world, in ancient or modern times, have devoted themselves to the study of epidemiology pure and simple. No one can earn a livelihood by it, and no man in this country has ever attempted to do what Sambon has done. He has devoted his life to the subject. There is no brass plate on his door; no patients call upon an epidemiologist for advice. The writer once heard Sir Patrick Manson say: "Sambon should be supported by the State," but that day has not come to pass and, in Sambon's lifetime, in all probability it never may. The writer, perhaps more than any other man, has had a glimpse into Sambon's "inner

life " and his struggles to live and carry out the work for which he is so eminently fitted. What a wonderful story he could tell! Sambon has braved even starvation for the sake of Science, but what a splendid record of work in archæology, geology, medical entomology, protozoology, helminthology and epidemiology! His is the many-sided knowledge, the broadmindedness necessary to form a true epidemiologist.

It fell to the lot of Professor F. Mesnil, a great French scientist, to place before us Sambon's work and tell the world what he has done. Acting as chairman of the meeting at the Pasteur Institute, after the words " Ladies and gentlemen " to the assembled host, turning to Sambon he said: " Dr. Sambon, I have had the honour of knowing you for



British experimental hut at Ostia (Roman Campagna), June-October, 1900. (From left to right Mr. A. J. Engel Terzi, Dr. L. W. Sambon, Dr. G. C. Low.)

over a quarter of a century; I remember when, sent by the British Colonial Office and the London School of Tropical Medicine, you went to the Roman Campagna to put the finishing stone to the great malaria edifice. I remember how, on your return, you laid before us the most definite, conclusive proofs of the truth of the mosquito-malaria theory. I remember the views you expressed with regard to the non-malarial origin of black-water fever, views adversely criticized at the time; we are proud that two of our own countrymen have proved that you were right. I remember how you worked out the ætiology of sleeping sickness, its transmission by a tse-tse fly, the necessary sexual cycle in the fly; you were right. I remember your indictment of the body-louse as the carrier of typhus fever: there again men of the Pasteur Institute proved, by actual experiment, that you were right. Dr. Sambon, you are going to speak to us about cancer, and we feel that what you are going to say, again, is going to prove true; therefore we will listen to you with attention, devotion and admiration.

The triumph of Dr. Sambon's life was reached at that great meeting at the Institut Pasteur in Paris, where, under Calmette's leadership, scientific France assembled to do him honour, and where, later, in the evening of the same day, at a splendid banquet, he was entertained in a fashion worthy of French hospitality.

In thanking Sambon for his address, the world-known scientist, Professor Emile Roux, Director of the Pasteur Institute, said that it was by means of researches so highly documented and scientifically conducted as those of Dr. Sambon that one could hope clearly to peer some day into a question hitherto so obscure. Therefore it was to be hoped that similar explorations should be continued and multiplied as much as possible.

The day after, Professor Calmette wrote to Dr. Sambon a letter in which he says: " The Pasteur Institute is very grateful to you for the address you so kindly delivered before its members, as also before the members of the Société de Pathologie

Exotique and its guests, the Professors of the Natural History Museum of Paris, the Faculty of Medicine, and the members of the French Association and of the Anglo-Franco-American Association for the fight against cancer.

"We are fully disposed to enter into the views which you have declared to us and to collaborate with you in the researches which obviously it would be extremely useful to carry out in different countries on the ætiology of cancer, and particularly on the part played by parasites in its genesis, a rôle which has been so well demonstrated by the researches of Professor Borrel in this Institute, Professor Fibiger at Copenhagen, Bullock and Curtis in America, and by your own."

Professor Borrel, Director of the Bacteriological Institute of Strasbourg, who had purposely come to Paris to attend Dr. Sambon's lecture, invited our epidemiologist to go with him to Strasbourg, and the result of that visit—some hours spent in Borrel's laboratory—is highly interesting. It was a great compliment from one scientist to another, and one pregnant with possibilities.

Another development which has emerged from Dr. Sambon's work is that his researches have stimulated others to follow in his path. Dr. Nègre, who translated his first report, went soon after to the south of France, there to carry out similar researches. These fully confirm Sambon's views and add much to our knowledge of the epidemiology of cancer. Then Dr. Ciurcentaler, recently Chief Medical Officer of the Trentino, after having assisted Dr. Sambon in his work in that province, continued the researches and has produced very valuable evidence in support of the parasitic nature of cancer, notably the striking map of Villa Lagarina (see p. 59), in which village during fifty years cancer attacked practically only a single street.

Dr. Sambon's paper is followed by two other important contributions by British Museum experts. The first is by Dr. H. A. Baylis, who, by kind permission of the Trustees, took part in Sambon's recent researches in the Trentino and Romagna and made a special study of the Gongylonema and other worms collected. If nothing else had resulted from the labours of the Commission, this one paper "On Gongylonema collected in Italy during October, 1924, with some observations on the Genus," would amply repay the few weeks and pounds spent in Italy.

Mr. K. G. Blair's contribution, "On some notes on the insects intermediary hosts of Gongylonema" is no less interesting.

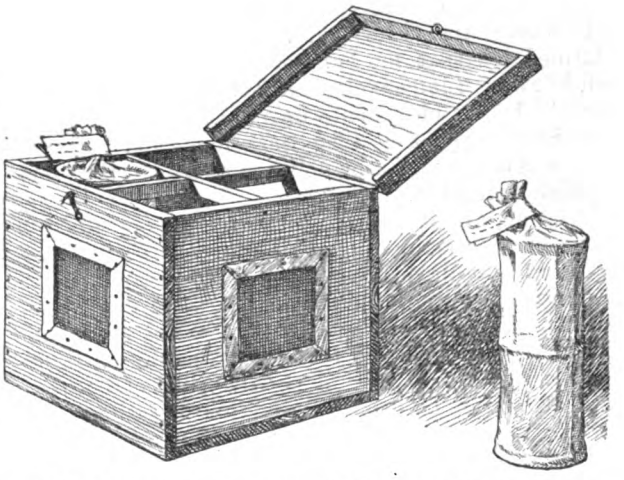
Finally must be mentioned the inimitable pen drawings of insects by Mr. A. Terzi, who, when asked the price, said it was his mite towards the furtherance of Sambon's unpaid work on cancer.

It was by means of a few pounds put up by some of his personal friends, chiefly physicians, and his own savings, that Sambon was able to go to Iceland and Italy and give us this invaluable report.

Sambon's work must be continued and without interruption. It is for us to see that some means be found to help him in his great fight to vanquish our most deadly malady.

In a brilliant article on our "Epidemiologist" published in the January last number of the *Whitehall Gazette and St. James's Review*, occurs a paragraph which we cannot refrain from transcribing here. It runs: "Dr. Sambon's report upon his inquiries in Romagna is a remarkable document of curiously wide learning and close argument, and it cannot fail to impress upon the medical world the importance of pursuing the investigation of cancer upon an epidemiological basis. It is to be hoped that this will be done with all the support which the British Empire Cancer Campaign can give, and, although the question in Ecclesiastes, "Where shall wisdom be found?" has not yet been finally answered, it may be suggested that it would be found in giving to Dr. Louis Westenra Sambon the charge of these inquiries."

JAMES CANTLIE.



Sambon's gauze tubes, suggested by cobwebs, and box in which malaria-infected mosquitoes travelled from Ostia to London in 1900.

RESEARCHES ON THE EPIDEMIOLOGY OF CANCER MADE IN ICELAND AND ITALY (JULY—OCTOBER, 1924).[1]

By LOUIS WESTENRA SAMBON, M.D., F.Z.S.

Lecturer in the London School of Tropical Medicine. Corresponding Member of the Société de Pathologie Exotique.

THE solemnity of this meeting, Professor Mesnil's far too flattering introduction and the generosity of your welcome, make me feel very keenly the inadequacy of my efforts.

The cancer problem which you have asked me to discuss is, without doubt, the gravest, most difficult and urgent with which modern science has to grapple. It is a problem which has baffled the

[1] Lecture delivered at the Institut Pasteur, Paris, on December 10, 1924.

centuries and one on which to-day medical opinion is so greatly divided that we see the layman take up our rattle and presume a knowledge of the causes which give rise to the awful malady.

I propose to lay before you a few epidemiological and parasitological facts bearing on the etiology of cancer gleaned during researches recently made in Italy and Iceland. These facts I owe, in considerable measure, to the courtesy and keen observation of local physicians and district health officers.

Expect nothing startling, only carefully ascertained facts which confirm similar observations made repeatedly in different countries and at different times, yet strangely ignored.

Early in life was I taught the truth of the old saying: "Nothing new under the sun." When about twelve, I lived in Naples. Large oleanders adorned our garden; these, full of fragrant rose-like blossoms, were infested by yellow aphids. I noticed that ants visited the parasitised branches and collected from the aphids droplets of a syrupy secretion which oozed out of long horn-like tubes upon the backs of their sap-distended abdomens. I told a family friend, the Italian zoologist Francesco Gasco, that I knew how and where the ants got their sweetmeats. He informed me that my Lilliputian confectioners were well-known; Linnæus had called them the "ant's cows." It was pleasant to hear that my observations were correct and that they were confirmed by those made a century earlier by no less a man than the great Swedish naturalist.

Later on, archæological studies taught one that no man can ever claim to have discovered or invented anything himself outright, because all discoveries, all inventions depend on previous successive discoveries and inventions, themselves the outcome of the labour of countless individuals through untold ages. They are the result, not only of positive, but of negative data also; not only of correct interpretations, but also of mistakes. This latter truth centuries of experience have crystallized into the proverb: "*Errando discitur.*"

On this occasion, I am not going to touch upon clinical, pathological, histological, or cytological questions concerning cancer, but, with all due respect to the successors of Bichat, Dupuytren, Laënnec and Cruveilhier, indeed because of the great regard I entertain for sound pathological work, I must express surprise at certain fantastic theories, such as those which ascribe malignant tumours to rebellious cells, embryonic remains or strange conjugations between blood and tissue cells! Nor can I here, in this sanctuary, where burns so vividly the flame of Pasteur's genius, pass unchallenged the claim of the pathologist who vaunts that he can produce cancer *de novo* by means of a few strokes of the magic tar-brush! Why, it is Van Helmont's trick reversed. You will remember, the good friar, physician and chemist claimed that he could produce mice out of soiled rags, a few grains of wheat or a morsel of cheese! It is all so simple, toasted cheese in the case of mice, coal-tar derivatives in the case of cancer. Surely you have not forgotten Pasteur's words to Pouchet in his memorable debate on spontaneous generation: "I will show you how the mice entered Van Helmont's pot."

The treatment question is deplorable, but I have neither aloetic pills, nor plague-preventing thieves' vinegar to propose. Certainly, in the course of my researches, I have come across some extraordinary remedies, but are they more efficacious than those now in common use? In Iceland, of old, a large crab was allowed to die over the homonymous tumour. In the Trentino, I was informed by Dr. de Bellat that lizards (*Lacerta agilis* and *L. muralis*) are still used in the treatment of cancer. These swift little reptiles, sunning themselves on the walls, or flashing across the road, are caught with the hand, or by means of a horse-hair noose, chopped up and fed raw to patients suffering from cancer. This remedy of raw minced-lizard is based on a very old folk-belief that cancer is an animal—a tiny snake or worm—which devours the tissues. Give it plenty of raw flesh and it will spare the tissues of its host! Dr. Vezzetti, of Borgo, vaunted the merits of violet tea, a very old remedy commended by Pliny the elder, agreeable to the poet-physician Francesco Redi and taken up nowadays by Professor Fichera of Rome. "What is your opinion?" asked Dr. Vezzetti, and I praised the exquisite beauty and delicious fragrance of the sweet violet, even suggested that like emetine in amœbic dysentery, so also violine might have some action on the cancer germs and agreed that tea, syrup or conserve of violets must prove as pleasant a cordial in the treatment of phthisis, rheumatism and cancer as strawberries in the treatment of sprue, but I felt that the Violet's reproach to Alice (Through the Looking-glass): "I never saw anybody that looked stupider than you do" must have applied forcibly to me.

Let us get rid of baseless theories and mock cures while we seek for solid facts which alone can lead us in the way of truth.

During my recent researches in Italy I had the valuable assistance of Dr. H. A. Baylis, helminthologist in the Natural History Department of the British Museum. He kindly undertook to help me in my field work and study any helminthological material which we might come across. Dr. Baylis has made some interesting observations on some of the worms collected and these he will describe to you presently himself. The determination of the entomological material has also been made by British Museum experts, of whom I am indebted particularly to Mr. K. G. Blair, Dr. W. T. Calman, F.R.S., F. W. Edwards and A. S. Hirst.

In the time at my disposal it would be impossible to give a full account of the numerous epidemiological and parasitological observations which I had the opportunity of making in Iceland and Italy. I must perforce limit myself to a very summary exposition of some of the more important.

Allow me to begin with Iceland.

In 1905 Professor Lazarus Barlow published a short note on cancer in Iceland based on data furnished by the Royal Board of Public Health in Copenhagen and by Dr. Jonasson, Chief Medical Officer at Reykjavík. He stated that cancer still

appeared to be an uncommon disease in Iceland though known at all times and fairly evenly distributed throughout the country. The available reports seemed to indicate that, though previously extremely rare, cancer had become more prevalent in 1896 when several medical men reported the occurrence of unusually numerous cases. Three years later, when the largest number of cases was recorded—27 in a population of 76,383—the ratio was 3·66 to 10,000 of population and 3·34 per cent. of all deaths above the age of 35 years. Nearly half the cases registered were cases of gastric cancer and Professor Barlow pointed out particularly the exceptionally large proportion of cancer of the alimentary tract. Uterine and breast cases were infrequent and cancer of the penis completely absent.

In 1922, Professor Gudmundur Hannesson, then Chief Medical Officer of Iceland, published a remarkable statistical work on the public health of his country covering the period 1911-20. Speaking of tumours, he points out that the cancer statistics are unreliable. "Some of the patients do not seek a doctor and are not registered, others are seen by more than one physician and are listed often twice over. The number of cancer cases reported by the doctors does not agree with the number of deaths due to cancer, the diagnosis is often merely clinical, and not confirmed either by post-mortem finding or

CANCER MORTALITY IN ICELAND, 1911–1920.

RATE PER 10,000 POPULATION.

	Districts.	
1.	Reykjavík	23.12
2.	Skipaskagi	13.67
3.	Borgarfjördur ...	13.73
4.	Borgarnes	0.68
5.	Ólafsvík	5.52
6.	Stykkishólmur ...	7.54
7.	Dalir...	8.34
8.	Reykhólar	8.85
9.	Flatey	13.93
10.	Patreksfjördur ...	5.62
11.	Bíldudalur	8.93
12.	Thingeyri	3.67
13.	Flateyri	7.58
14.	Isafjördur	5.52
15.	Nauteyri	5.85
16.	Hesteyri	2.76
17.	Strandir	6.96
18.	Midfjördur	2.46
19.	Blönduós	0.83
20.	Saudárkrókur ...	12.25
21.	Hofsós	1.12
22.	Siglufjördur	6.67
23.	Svarfdæla	6.42
24.	Akureyri	11.34
25.	Höfdahverfi	3.21
26.	Reykdæla	2.67
27.	Húsavík	9.56
28.	Öxarfjördur	8.31
29.	Thistilfjördur ...	18.00
30.	Vopnafjördur ...	5.45
31.	Hróarstunga... ...	2.91
32.	Fljótsdalur	8.49
33.	Seydisfjördur ...	8.32
34.	Nordfjördur	4.74
35.	Reydarfjördur ...	3.88
36.	Fáskrúdsfjördur ...	7.18
37.	Berufjördur	2.52
38.	Hornafjördur ...	6.16
39.	Sída	4.85
40.	Mýrdalur	—
41.	Vestmannaeyjar ...	1.66
42.	Rangá	6.67
43.	Eyrarbakki	5.61
44.	Grimsnes	2.00
45.	Keflavík	5.48
46.	Hafnarfjördur ...	8.92

STATISTICS OF CANCER MORTALITY IN ICELAND, 1911–1922.

Districts	Average population 1911-1922	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Total
1. Reykjavík	13,833	25	35	34	30	24	21	36	37	49	28	42	41	402
2. Skipaskagi	1,609	2	3	4	2	1	1	2	2	3	2	2	4	28
3. Borgarfjördur	1,602	2	5	2	2	1	2	2	2	4	—	1	2	25
4. Borgarnes	1,467	—	—	—	—	—	—	—	—	—	1	—	—	1
5. Ólafsvík	1,629	3	1	—	1	2	—	—	—	2	—	2	—	11
6. Stykkishólmur	1,854	4	—	—	3	2	1	2	2	—	—	1	—	15
7. Dalir	2,038	—	—	4	—	4	2	1	—	3	3	—	1	18
8. Reykhólar	587	1	—	—	—	—	1	—	—	3	—	—	—	5
9. Flatey	575	—	1	—	—	—	—	3	1	2	1	—	—	8
10. Patreksfjördur	1,067	2	—	—	2	2	—	—	—	—	—	2	—	8
11. Bíldudalur	672	—	—	—	1	1	—	1	1	1	1	2	2	10
12. Thingeyri	1,363	1	—	—	—	1	1	1	—	1	—	1	—	6
13. Flateyri	1,188	1	2	2	1	—	2	—	—	—	1	1	—	10
14. Isafjördur	3,819	2	2	2	2	—	—	4	1	4	4	4	7	32
15. Nauteyri	854	—	—	—	3	—	—	1	1	—	—	2	1	8
16. Hesteyri	724	2	—	—	—	—	—	—	—	—	—	—	—	2
17. Strandir	1,437	—	2	2	1	2	—	—	1	—	2	2	1	13
18. Midfjördur	2,021	—	—	—	—	—	—	2	2	—	1	—	—	5
19. Blönduós	2,403	—	—	—	—	1	—	—	1	—	—	1	—	3
20. Saudárkrókur	2,449	7	2	3	—	3	6	2	2	2	3	5	2	37
21. Hofsós	1,789	1	—	—	—	—	—	—	1	—	—	—	—	2
22. Siglufjördur	898	1	—	1	2	—	1	1	—	—	—	1	—	7
23. Svarfdæla	2,025	—	2	1	1	1	—	1	2	3	2	2	2	17
24. Akureyri	5,166	4	6	1	4	8	7	10	6	4	11	13	10	84
25. Höfdahverfi	936	1	—	—	—	—	1	1	—	—	—	—	1	4
26. Reykdæla	1,116	—	1	1	—	—	—	—	—	—	1	1	2	6
27. Húsavík	1,463	—	3	1	2	2	3	1	1	—	1	1	3	18
28. Öxarfjördur	842	1	—	—	—	—	1	—	—	5	—	2	—	9
29. Thistilfjördur	944	1	2	1	1	4	1	1	2	2	2	1	1	19
30. Vopnafjördur	734	—	1	—	—	1	—	—	—	2	—	—	1	5
31. Hróarstunga	1,388	—	—	—	—	—	1	1	2	—	—	—	—	4
32. Fljótsdalur	1,059	—	—	2	—	2	—	—	2	2	1	1	—	10
33. Seydisfjördur	1,196	—	2	3	3	1	—	—	1	—	—	—	1	11
34. Nordfjördur	1,253	—	—	—	—	—	—	2	—	2	2	1	1	8
35. Reydarfjördur	1,285	—	—	—	1	2	—	1	—	—	1	1	1	7
36. Fáskrúdsfjördur	1,113	—	1	1	1	1	—	2	1	—	1	—	—	8
37. Berufjördur	833	—	—	—	—	—	—	—	—	2	—	1	—	3
38. Hornafjördur	1,135	—	—	2	1	—	1	—	1	2	—	—	—	7
39. Sída	1,008	—	—	—	—	1	3	1	—	—	—	—	—	5
40. Myrdalur	1,708	—	—	—	—	—	—	—	—	—	—	—	—	0
41. Vestmannaeyjar	1,672	—	1	1	—	—	—	—	—	—	1	2	4	9
42. Rangá	3,124	1	1	5	2	—	4	4	2	2	2	1	3	27
43. Eyrarbakki	3,876	3	5	1	2	—	3	1	2	1	3	5	2	28
44. Grímsnes	2,214	1	—	—	—	—	1	—	1	2	—	4	4	13
45. Keflavík	2,563	1	4	2	3	—	1	1	—	1	1	2	2	18
46. Hafnarfjördur	2,944	2	1	4	4	2	6	1	3	2	3	6	2	36
Total	88,134	69	83	80	75	69	71	86	80	106	79	113	101	1,012

microscopical examination. However, the figures show that there were fewer cases recorded in the first five years than in the last, but the increase seems hardly greater than would be expected on account of the increase of population from 85,573 in 1911 to 94,690 in 1920. In the years 1911-15 there were reported on an average, 8·6 cases and 9·9 deaths per 10,000 of population, whilst in the period 1916-20 there were reported 9·2 cases and 10·6 deaths per 10,000 of population. With regard to site-incidence, the disease affected, more especially, the alimentary tract. After the stomach (46·9 per cent.), the œsophagus (9·7 per cent.), the liver (8·6 per cent.), and the intestine (3·3 per cent.), came the female breast (10·5 per cent.), and the uterus (3·8 per cent.).

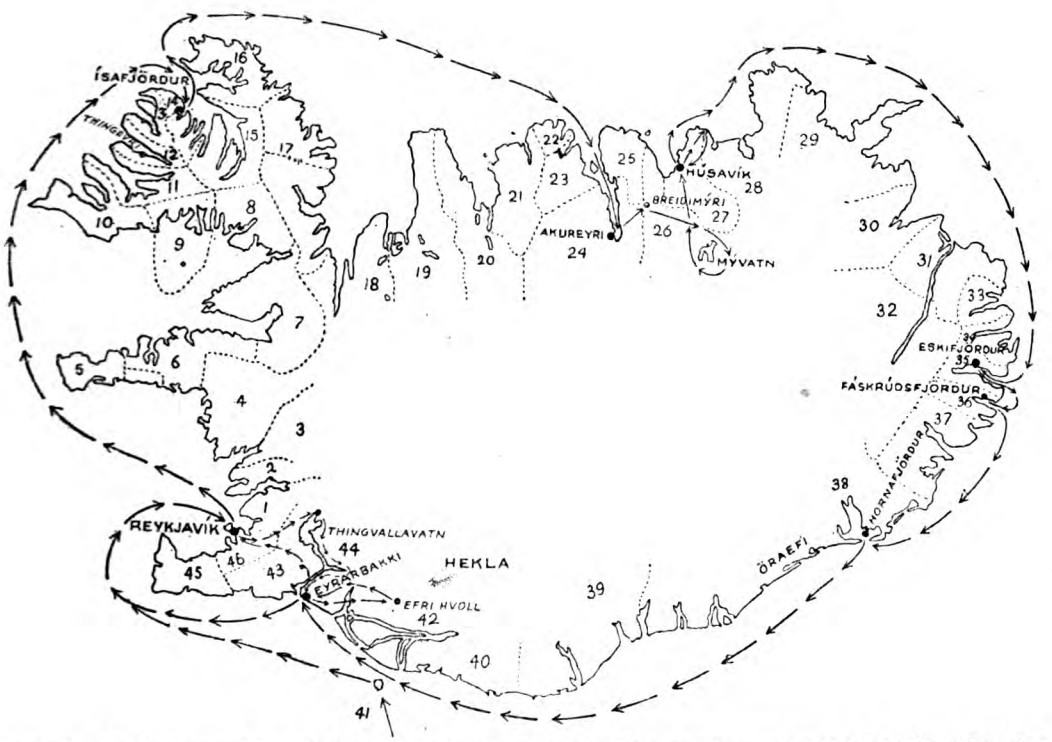
Invited last summer to revisit Iceland and attend the *Lœknafundur* or National Medical Congress which was to be held in Akureyri, I left Leith by the Icelandic steamer *Lagarfoss* and reached Reykjavík on July 26. On landing, I was met by Professor Gudmundur Finnbogason, an eminent philosopher and writer, Rector of the University, and by Mr. Örn Benediktsson, my assistant, who had preceded me to make all arrangements. The very next day I left for Akureyri on board the Danish steamer *Island*, together with Professor Gudmundur Björnson, Chief Medical Officer of Iceland, Professor Hannesson, Doctors Thórdur Thoroddsen, Gudmundur Thoroddsen, Thórdur Edilonsson, Konrád Konrádsson, Jón Kristjánsson and other physicians from the capital and the southern districts, who were going to attend the congress. Unfortunately, a severe epidemic of acute poliomyelitis, which greatly hampered my researches, already had spread widely throughout the

island and this prevented the majority of physicians from joining us.

After leaving Reykjavík, our first landing was at Isafjördur, the principal trading station on the north-west coast. The district of Isafjördur has a population of 2,500 or a little more. Together with Professor Hannesson, most agreeable of travelling companions, who everywhere kindly acted as my guide, interpreter, and instructor, I called on Dr. Jonsson, who had been medical officer of the district for about five years. We sat on chairs made of the bones of a whale, round a table of the same material, and were regaled with excellent coffee and cakes. Dr. Jonsson told us that in the five years he had seen twenty-one cases of cancer distributed as follows: stomach six, œsophagus four, peritoneum four, liver two, colon one, rectum one, breast one, urinary bladder one, epididymis one. He had performed orchotomy in his case of cancerous sarcocele and had been anxious to watch the outcome, but, unfortunately, the patient was drowned soon afterwards whilst out fishing. The microscopical examination of the neoplasm made at Reykjavík proved it to be a carcinoma. Rats and mice abounded in Isafjördur, whilst every boat that approached the landing-stage brought cockroaches (*Blattella germanica*), but he had not seen these insects in any of the houses and remembered one only infested by bedbugs. We visited the old hospital and there I had the opportunity of examining a woman about 32 years of age, suffering from cancer of the œsophagus. From the old we went to the new hospital, which was being erected on plans drawn by Professor Hannesson, who excells in architecture as he does in medicine and philosophy.

From Isafjördur we steamed to Akureyri, a bright little town charmingly situated near the head of the Eyjafjördur, on the north coast of Iceland. There met, on July 31, the Icelandic Medical Association and there, in a superb school building, I had the honour of addressing them on the elucidation of cancer.

From Akureyri, accompanied by the son of my distinguished friend Dr. Steingrimur Matthiasson, I travelled on pony-back across mountains and valleys, rivers and snow drifts, scaring the sheep and reindeer, putting up ptarmigan, plover and curlew. We passed a small forest of beech which nestled in the Fnjóskadalur or "Touch-wood Valley," skirted the Ljósavatn or "Lake of Sparkling Water" and tarried to watch the roaring, deafening Godafoss or "Fall of the Gods," arriving in the small hours at Breidimýri, where we were most hospitably received by Dr. Sigmundu Sigurdson, the district medical officer of Reykdæla.



Map of Iceland showing position of places visited or mentioned. (The numbers indicate the Medical Districts and correspond to the numbers placed before the District names on mortality charts.

The district of Reykdæla has a population of about 1,200 inhabitants, scattered over a vast volcanic region which enchases a wonderful sapphire, the Mývatn or "Midge Lake," full of trout and wild duck. In this district, during a practice of over sixteen years, Dr. Sigurdson had seen only eleven cases of cancer: one in 1912, one in 1913, one in 1920, four in 1921, four in 1922. With regard to site incidence, they were distributed as follows: stomach six, breast two, lip one, maxilla one, intestine one.

Poliomyelitis was rampant at Breidimýri and all Dr. Sigurdson's children had contracted it. In a cottage built of lava slabs and turf, close to the doctor's house, I had the opportunity of examining two grave cases with multiple paralyses. However, Dr. Sigurdson and I were able to make a journey of three days' duration round the lake and visited not only farms and patients, but saw also vast craters of explosion, mud volcanoes and painted solfataras, beautifully variegated with indigo, yellow, white and crimson, but belching forth acrid, suffocating vapours. We passed through great lava fields with petrified torrents wedged and twisted into nightmare forms, more terrible than the Dinosaurs of the Mesozoic era, more grotesque than the gargoyles of Nôtre Dame. In these Phlegræan haunts we were assailed by thick black clouds of sand-flies (*Simulium vittatum*) which harassed us exceedingly, entering eyes, ears, mouth, nostrils, and giving us a foretaste of the Inferno.

Whilst riding to the south-west of lake Mývatn, picking our way under a downpour of rain through swamp and beech-covered frost-knolls, we met a tall, lean, red-haired man who dismounted and approached the doctor. He exhibited a growth with hard, indurated base, which protruded from the middle of the lower lip and had appeared three months previous at the edge of a leucoplasia. "An epithelioma!" exclaimed Dr. Sigurdson whilst feeling the man's submaxillary glands, and then we both examined the patient, a very poor farmer, 57 years of age. The doctor advised him to go to the hospital at Akureyri, and the farmer gave us a grip of his hand, cold and boney, like the hand of death. He left us with calmness and resignation in his saddened face.

How strange that weird consultation, under a pelting rain-storm in the middle of the wild, desolate moor! Sigurdson was obviously moved; he knew the man. I followed in silence, full of admiration for the country doctor, truly a good Samaritan, who faces daily endless difficulties, fatigues and perils in the execution of his duties. I have seen him at work in tropical jungles, beneath a blistering sun; I have seen him in northern latitudes fitted with "ski," braving the blinding snow-storm; I have seen him tear himself from his own sick child to go and aid a parturient woman in the middle of the night. He has given me freely all the knowledge he had acquired in long years of study and practice; first-hand knowledge, true, accurate, valuable. Indeed, forget not, out of his ranks rose the Hameaus and the Brettoneaus!

On the morrow, I left for Húsavík, a small station on the eastern shore of the bay of Skjálfandi. On arrival I called on Dr. Björn Josefsson whom I had met at Akureyri. He informed me that the district of Húsavík has a population of 1,598 inhabitants. During his sixteen years practice in this district he had seen eight cases of cancer (breast four, stomach two, lungs one, maxilla one). For six and a half years before he had practised in the district of Öxarfjördur and there had seen one case of gastric carcinoma in a woman whose sister some years later died also of cancer of the stomach in Húsavík. Dr. Josefsson had seen cancer of the glans penis in a pony and cancer of the maxilla in a sheep.

Poliomyelitis was still rife at Húsavík; the first case had occurred on June 13, since when the doctor had treated one hundred and eleven cases. Almost every family with children had been attacked. One was reminded of the tenth plague of Egypt, the death of the first-born!

Whilst in Dr. Josefsson's consulting room, I caught some flies which were walking leisurely on the window panes, they were specimens of *Fucellia fucorum* which had come in from the shore strewn with great brown seaweeds (*Fuchus* and *Laminaria*) and with countless heads of cod drying in the sun to serve as fodder for sheep and cattle in winter.

From Húsavík I embarked on the Icelandic steamer *Esja* and, so doing, rejoined the Congressmen who had boarded her at Akureyri.

Stopping at Reydarfjördur, on the East Coast, I landed, whilst our ship took in cargo and, together with Professors Björnson and Hannesson, called on Dr. Sigurdur Kvaran who had been for eleven years in the district of Reydarfjördur. He told us that he saw, as a rule, from two to three cases of cancer each year. He had seen malignant tumours in stomach, œsophagus, lip, liver, breast and uterus. He believed the disease to be infectious. People, whether related or not, seemed to contract it, not from one another, but from some common source whilst living in or frequenting the same house. He remembered two cases, one of the lip, the other of the stomach in persons distantly related, but living in the same house. More than once had he observed a case in one farm followed by another case in a neighbouring farm.

Our next landing was at Fáskrúdsfjördur where we were lavishly entertained by Dr. Georg Georgsson in a palatial residence built, like the adjoining hospital, by the French Government. Dr. Georgsson was also French Consul and the tricolor flag fluttered coquettishly over his dwelling. In his study was a beautiful bronze bust of Liberty and on the dining table other penates in the shape of champagne bottles, together with dishes of cakes and boxes of fragrant Havana cigars. Our stay was short at Fáskrúdsfjördur and Dr. Georgsson so much in demand by the *Esja's* passengers, who had turned out *en masse* to pay him homage that my notes on cancer from this locality are scanty in consequence.

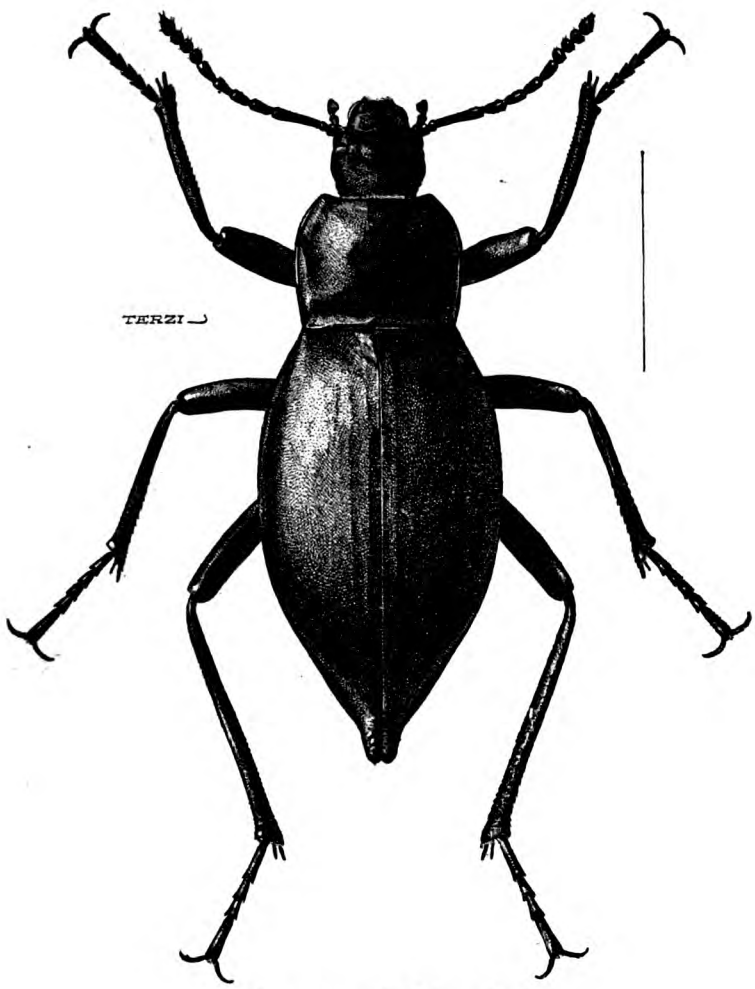
Then we went to Hornafjardarós near the Vestrahorn or Cape West. It is a small maritime station at the bottom of a lagoon formed by two gulfs, the Skardsfjördur and the Hornafjördur, and divided from the sea by a long sand-bar. Taking advantage of the tide, we crossed the land-spit through a narrow shallow passage, whilst clouds of sea birds rose shrieking from the bar. In this very lagoon had alighted on August 2 and 3 respectively the two American aviators Nelson and Smith in their great world flight.

Landing at a stage strewn with coarse salt, where cod was being split, cleaned and salted, I went with Professor Hannesson to visit the district physician, Dr. Henrik Erlendsson, a short, square sturdy man of pleasant appearance and charming manners who spoke Danish, English, French and Italian, almost as fluently as his own language. He told us that he

had practised in the Hornafjördur district for over twelve years. His district was wide and difficult. It took him no less than five days hard pony-riding to travel from the furthest eastern farm to the most southern or western, crossing innumerable glacier-streams and rivers, swollen and dangerous in winter. The population under his care numbered about 1,200. During his twelve years of practice he had seen but five cases of cancer, all gastric. He well remembered a young man from the Lagoon parish who had died of carcinoma of the cardiac portion of the stomach at the age of thirty-seven. He used to gulp down his coffee boiling hot. Another case was that of an old clergyman whose gastric tumour was complicated by hepatic metastasis.

The district of Hornafjördur is divided into five parishes: Mýrar (the northern parish), Sudursveit (the southern), Nesjar (the Peninsula), Lón (the Lagoon) and Öræfi (the Desert). Dr. Erlendsson had never seen cancer cases in Öræfi, and it is noteworthy in this connection that neither rats, nor mice, nor cockroaches have ever been seen in this parish. Rats and mice are great travellers, as everyone knows, but they had never been able to reach the parish of Öræfi on account of the vast sand stretches, glaciers, wide rivers and many streams which barred their way. This parish contains about twenty farms or collections of cottages with a total population of about 250 inhabitants. The farmers have to drive their flocks of sheep miles over the glaciers to bring them to the rare pasturages, scattered like oases over a wild, inhospitable land of sliding glaciers and drifting volcanic sands.

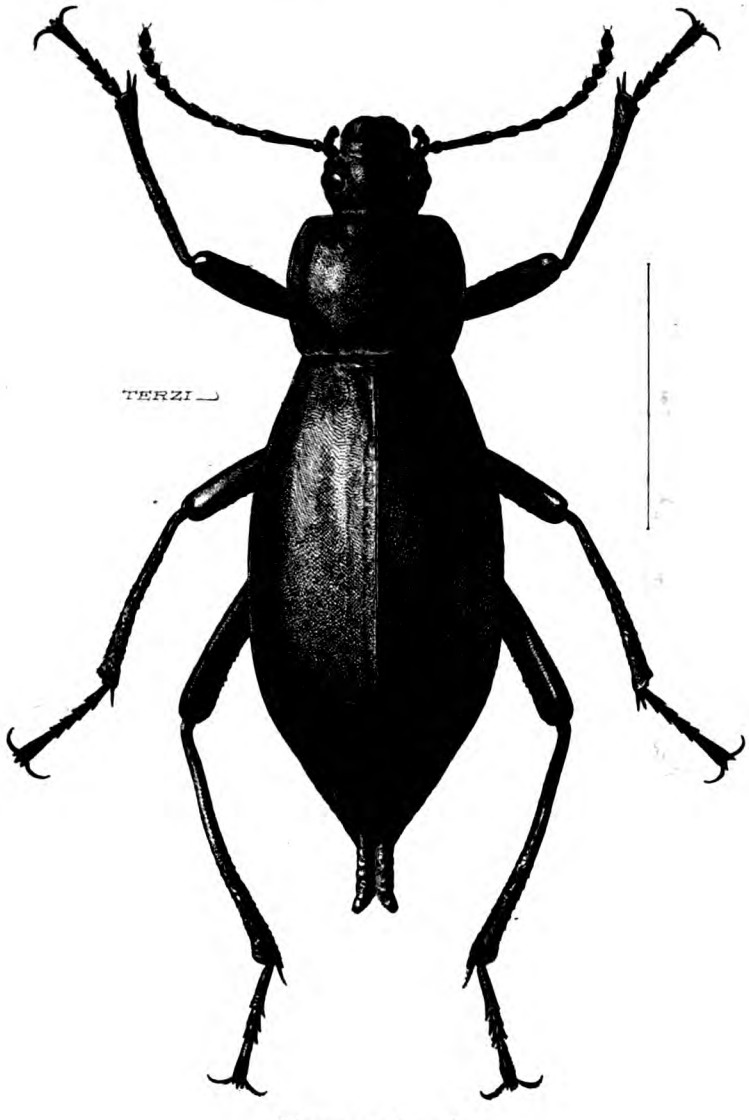
The last landing, before we returned to Reykjavík, was Eyrarbakki, a port, or rather anchorage, on the south coast, bad but necessary, in the waters of which we saw some seals. Here I called on Dr. Peturson, the district medical officer whom I had met two years before at the time of King Christian's visit to his island kingdom. Dr. Peturson had practised there ten years, and he told me that since 1915 he had seen twenty-one cases of cancer distributed as follows: stomach, thirteen; œsophagus, one; tongue, one: larynx, one; maxilla, one; liver, one; colon, one; breast, one; urinary



Blaps mucronata Latr. ♂

bladder, one. The district has a fishing population of 3,540 inhabitants.

With Professor Hannesson and Dr. Peturson I visited two bakeries, one of which was forty years old and had a large brick-built oven. It was managed by a Danish baker who had lived in Eyrarbakki since 1909. This man told us that occasionally he found meal-worms in meal imported from Britain and America, but that he had never seen either the cockroaches or the crickets, which are such frequent sub-tenants of Danish bakehouses.



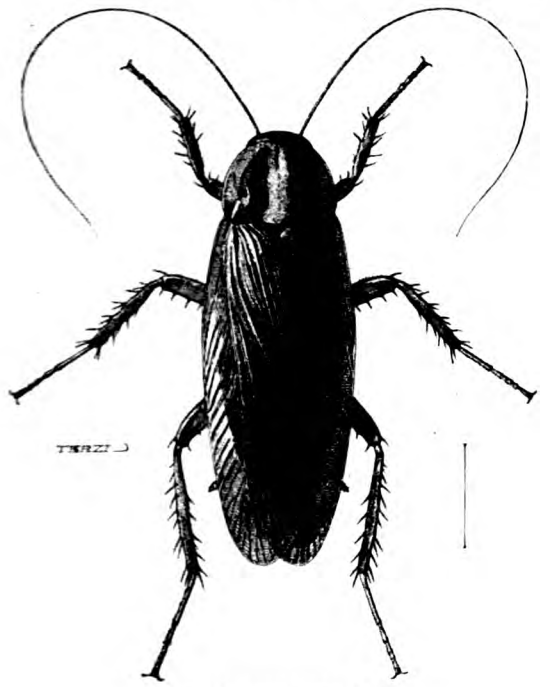
Blaps gages L. ♂

On my return to Reykjavík I made inquiries concerning the presence of *Blattidæ* and *Tenebrionidæ* in Iceland. Dr. Bjarni Sæmundsson, Director of the Natural History Museum, showed me specimens of *Blaps mucronata* and of *Blaps gages* found at or near Reykjavík, but he could not tell me whether they had been found elsewhere on the island. Probably the museum specimens had been imported from abroad with merchandise. The insect which seems to take their place in Iceland is a coal-black beetle of which there were a few, as yet undetermined, specimens in the museum. It is very common throughout the country and is popularly known everywhere by the name of "járnsmidur," the "blacksmith." I have collected specimens myself at Húsavík, Thingvellir, Ægisida and Eyrarbakki. Mr. Blair believes it to be a species of *Pristonychus*, probably *P. terricola*. It had not been recorded previously from Iceland.

At the Reykjavík museum there was a specimen of the American cockroach (*Periplaneta americana*) which had been found in 1915 in a barrel of apples as well as some specimens of *Blatta orientalis* found in a Reykjavík storehouse. There were specimens also

of *Blattella germanica*, which is scattered widely throughout the island, though apparently restricted to certain localities. The specimens in the museum collection came from two very different places: from Reykjavík and from Thingeyri in the Dyrafjördur on the north-west coast of Iceland. Dr. Sæmundsson himself had collected *B. germanica* at Reykjavík in 1922 from a lowly hostel called the "Sudurpoll," or "South Pole," which harboured also numerous bed-bugs. He had found them again on the good ship *Ceres*, a Danish boat in which he travelled from Akureyri and, on reaching home some were discovered in his luggage.

With Professor Björnson I visited several private dwellings, eating-houses and stores in Reykjavík where cockroaches were said to have been found and I succeeded in collecting them in plenty from a well-furnished flat, inhabited by a charming newly-wedded



Blattella germanica (L.) ♀

couple, from a bakery, a pastry-cook's, a first-class restaurant and a barber's shop. They were all specimens of *B. germanica*. Whilst hunting in the last-named place the director of the Reykjavík lunatic asylum came in and, seeing me bottling cockroaches, invited me to visit his establishment. Professor Björnson was highly amused, but the alienist explained that he was offering me big game, because the asylum was infested by larger and darker cockroaches.

On all the ships I visited in the port of Reykjavík, as in those in which I travelled, I found *B. germanica* very much at home, so I have no doubt that, as in the case of rats, cockroaches must have been imported into Iceland by means of sea-commerce since early days.

The chief veterinary surgeon at Reykjavík told me that on several occasions he had observed cancer of the penis and sheath in ponies and malignant tumours of liver and ovaries in cattle. Frequently he had found worms in the intestines of sheep, cows and ponies, but he had not looked for, or seen Gongylonema. He had not preserved his material and the museum did not contain any parasitological collection.

The physicians told me that in man the pinworm (*Oxyuris vermicularis*) was very common, but that the eelworm (*Ascaris lumbricoides*) and the whipworm (*Trichuris trichiura*) were practically unknown. Already, in 1874, Finsen had pointed out the great frequency of the pinworm and the rarity of the eelworm.

Iceland has long been known as the classic land of hydatid disease, but nowadays echinococcosis has diminished in frequency as strikingly as yellow fever at Panama, following the application of preventive measures judiciously based on true and precise etiological knowledge. Fifty years ago, when echinococcosis was believed to be a hereditary disease (Skaptason), the proportion of Icelanders affected was about 1 in 40, to-day it is below 1 in 2,000, and varies from one district to another in accordance with the stringency used in the application of preventive measures (destruction of infested viscera, systematic treatment of dogs).

Another disease which has diminished greatly in Iceland, as in other European countries, is leprosy. Some cases do still crop up from time to time, especially on the eastern and northern coasts, but they are very few.

Syphilis is of particular importance in view of the ætiology of cancer, because, apart from the error of believing cancer to be a modification or degeneration of the venereal disease, the syphilitic lesions are looked upon by some as "pre-cancerous" conditions. Now, in Iceland, although cases of syphilis have been observed not only in foreigners, but also in Icelanders at some of the principal ports such as Reykjavík, Akureyri, Siglufjördur, Seydisfjördur and Eyrarbakki, the country may be said to be still free from this loathsome disease. Professor Hannesson's statistics prove it. At Hornafjördur, Dr. Erlendsson told me that he had never seen syphilis in his district, excepting once only in a foreign seaman. Dr. Sigurdsson assured me that in the district of Reykdæla he had never seen either syphilis, gonorrhœa, or chancre.

I regret that time will not allow me to mention all the observations made in Iceland anent cancer, because they overturn many theories which may seem plausible enough in the places in which they originated, but appear absurd elsewhere. For instance, the eating of pork frequently has been adduced as a cause of cancer; certainly in France the hog's flesh forms the basis of the animal food of the great majority of the rural population, but in Iceland there are few, if any, pigs at all and the Icelanders (save very few in Reykjavík) do not eat pork either fresh or salted. It is true that swine were imported into Iceland in 890 by Helgi "the lean" and that we find them often

mentioned in the old sagas, for the most part wild and wandering in droves, others, a ring through the snout, tended by slaves, but, though pork was esteemed and sucking-pig relished, pigs were dwindling in the fourteenth century and gone in the fifteenth. In 1910 a few swine were imported again into Iceland for the purpose of breeding them, but the experiment seems to have failed. Possibly there may be a few domestic swine in Iceland, but I never saw any.

The absence or rarity of the hog in Iceland might well explain the absence or rarity of certain parasitic diseases such as the cysticercosis of porcine origin and trichinosis. Maybe it might explain also the absence or great rarity of *Trichuris* and *Ascaris* among the Icelanders. The absence or quasi-absence of these two round worms in a country devoid of swine and their frequency in other northern countries (Finland, Greenland), where hogs are raised, would tend to confirm a doubt long entertained that *Ascaris suum* and *Trichuris crenata* of the hog might not differ specifically from *A. lumbricoides* and *T. trichiura* of man, but represent merely varieties, or rather host races—human and porcine—interchangeable.

Similarly, one might demolish other alimentary theories such as those which ascribe cancer to the eating of tomatoes, water-cress or white bread. The food of the Icelander consists of milk, eggs, fish, meat, rye-bread and one or two vegetables. The milk is taken cold or in the form of "skyr," a soft white cheese of attractive texture and flavour, made from fresh milk curdled by souring and rennet, and served with cream and sugar. The fish is eaten boiled and served with melted butter. It may be cod, ling, hake, haddock, pollock, herring, mackerel, plaice,skate, lump-sucker, cat-fish, shark, turbot, halibut, trout or salmon; fish dried into biscuit-like crispness (hardfiskur) or salted (saltfiskur), cured herring and smoked salmon or trout. The meats are usually mutton, either fresh (September, October) or salted and smoked, sometimes beef or seal, rarely horse-flesh, often feathered game such as swan, duck, ptarmigan, puffin, plover and curlew. Of vegetables they have few: potatoes, turnips, sorrel, angelica, rhubarb and sweet laminaria; of fruit: red-currant, wild strawberry, bilberry and crowberry. Their bread is usually unleavened and made either entirely of rye or of a mixture of rye and wheat, but of wheat flour they make excellent cakes and the best of pancakes served hot or cold with currant, strawberry or prune-preserve between their folds, with sugar sprinkled over. They use imported cereals such as rice and oats as well as lentils, currants and spice; they are, with the French, the best coffee-brewers in the world. Yet they have not the scarlet tomato, neither have they watercress.

Let us not forget that hardly half a century ago, echinococcosis was believed to be a food disease. To Thorstensen, chief medical officer of Iceland, it was the excessive use of cold meat which caused the disease, to another Icelandic physician, mentioned by Schleisner, it was the unleavened bread, to others again the paucity of vegetable food. If to-day we knew not the actual cause of hydatid disease, I have no doubt it would be put down either to lack or to excess of vitamines.

Let us turn to Italy.

In the first place I must mention briefly a few facts gleaned the summer before last when first I began my cancer researches in the fertile alluvial plains of Romagna, on the Adriatic coast, between Ravenna and Rimini. These observations, already published in the *Proceedings of the Royal Society of Medicine*, and, more fully, in the *Journal of Tropical Medicine*, have had not only the honour of a translation by Dr. Nègre of this Institute, but confirmation also from the results of similar researches which he has carried out recently in France.

I pointed out that the topographical distribution of cancer in Romagna presented striking inequalities well known to the local physicians.

Already, in an unpublished work, kindly placed at my disposal, Professor Testi and Dr. Galli, of Faenza, had described the irregular distribution of the disease in the town and territory of Faenza.

Professor Ortali, chief surgeon in the Ravenna hospital, informed me that at Mezzano, a village of about 1,500 inhabitants, he had found cancer cases in almost every family.

At Castiglione di Cervia, a locality long immune, he had seen four cases which had occurred suddenly in different families all at about the same time.

Dr. Chiadini, of Forli, stated that while cancer frequently occurred in the parishes of Romiti, Villagrappa, Villanova and Castiglione of Forli, it was unknown in the parish of San Varano, or, at any rate, during the last fifteen years not one case had been seen or heard of there.

Similar inequalities in the topographical incidence of cancer have been noticed throughout the world and have been reported frequently, yet they have not received the attention they deserve. To my mind, they strongly support the parasitic theory and, if properly investigated by competent men, should lead inevitably to the elucidation of the ætiology of cancer.

I gave examples also of the "cancer-house" so persistently ignored, yet repeatedly cited. I described two such houses shown to me by the local health officers. One was at Cotignola, a small town of about 7,000 inhabitants, on the River Senio. It was situated in Via Farini and bore the number 44. Five cases of cancer had occurred in this house in different families which had inhabited it within a short period. I examined the house very carefully; it was old and somewhat dilapidated, but well built, spacious, amply ventilated and clean. Having discovered evidence of the presence of cockroaches in two of the rooms on the ground floor, I asked permission to inspect the adjoining building. This granted, I found that the two rooms mentioned backed an old bakery oven. On inquiry, the proprietress of the bakery declared her oven-room so badly infested by cockroaches that, notwithstanding repeated endeavours at eradication, she had not been able to make the least impression on the swarming insects. Rats were seen frequently in the courtyard and mice in the bakery.

The second example was that of Predappio, a hill village of about 3,000 inhabitants, placed on the road

which, following the upper course of the River Rabbi, leads from Forli into Tuscany. Here, in Via Mulino, I saw two contiguous houses where five cases of cancer had occurred. One belonged to the family Capacci, the other adjoined a mill and was inhabited by the miller Francesco Zoli. In the former two cases of cancer had occurred, one of the breast, the other of the stomach, while in the latter the miller had lost father, mother and grandfather from cancer of the stomach. This house was full of sacks of grain and flour. Both buildings were infested by mice, rats, cockroaches and other household pests attracted by meal.

Another observation of importance relates to the organ or part of the body affected. In Romagna, cancer was a disease essentially of the upper part of the alimentary tract (œsophagus, stomach, pharynx, buccal cavity, tongue) and more especially of the cardiac portion of the stomach. This fact, revealed by the figures of site incidence, kindly supplied by the health officers and by the directors of the hospitals of Ravenna, Bologna, Faenza and Forli, was confirmed by my own observations and by the experience of Dr. Utili, radiographer to the Faenza hospital, who particularly insisted on the location of cancer at either the cardiac orifice or lesser curvature, and produced convincing radiographs in proof of his contention.

The inspection of farmhouses and dwellings in which cases of cancer had occurred revealed invariably infestation by the common cockroach (*Blatta orientalis*). These insects, as a rule were found in the meal-ark, an indispensable article of furniture present in all farmhouses. Besides cockroaches, I found in the meal-flour Meal-beetles (*Tenebrio molitor* and *T. obscurus*), Meal-moths (*Asopia farinalis*) and Meal-mites (*Aleurobius farinæ* and *Tyrogliphus longior*). In the stables adjoining the living rooms of farmhouses, beneath the alfalfa fodder-heaps, always I found Cellar-beetles (*Blaps gages* and *B. gibba*) as well as wood-lice (*Porcellio*), whilst mice, field-mice and rats everywhere abounded.

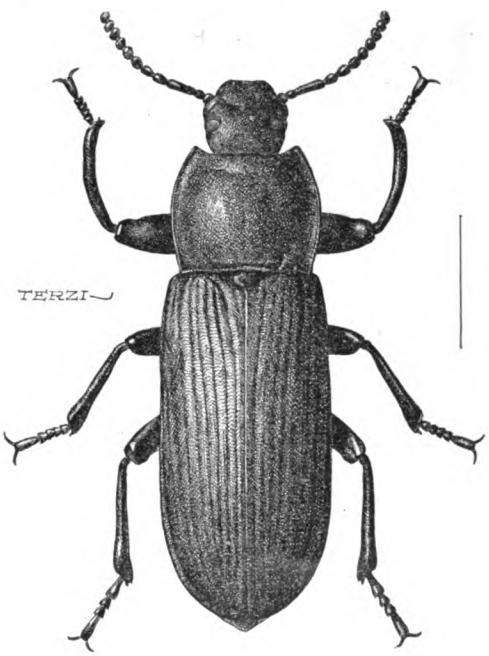
The observations made in Italy in 1923, proved:—
(1) The striking inequality of the geographical and and topographical distribution of cancer.

(2) The extraordinary frequency of the disease in the upper portion of the alimentary tract, especially the œsophagus and the cardiac end of the stomach.

(3) The constant presence of rats, mice, cockroaches, cellar-beetles and meal-worms in houses presenting one or more cancer cases.

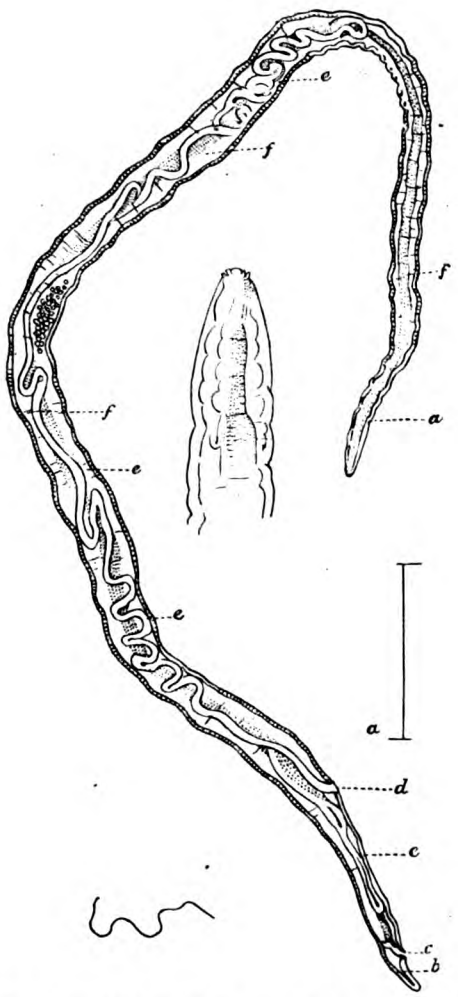
These facts led me to wonder whether a possible infestation with Gongylonema might not explain at least some of the cancer cases met with in Romagna. Professor Fibiger's researches and experiments on the part played by a Gongylonema in bringing about gastric carcinoma in rats are well known. But my Italian researches lasted less than three weeks and when the Gongylonema idea began to take shape in my mind I was back in England, so I turned to literature and found that in 1916 an immature form of Gongylonema had been found in a man by Professor Henry Ward, of Urbana (Illinois). Further, I found that as many as four cases of Gongylonema infection in man had been recorded from the United States of America by Ward, Stiles and Ransom. All these were cases of immature forms found in the region of the lips. But there were no like records from the old world. Checked, I hunted up all references to undetermined or wrongly placed nematodes found in the lip and upper portion of the alimentary tract of man. This brought me Pane's *Filaria labialis*.

Professor Carlo Pane, of Naples, as long ago as 1864 had described under this name a nematode, found beneath the epithelial covering of the upper lip in a Neapolitan medical student. His description showed at once that the worm could not be a filaria because its vulva opened at the posterior instead of the



Tenebrio obscurus Fab.
The dark Meal-Beetle,

anterior extremity. Pane's description was insufficient to lead to identification, but happily, his paper was illustrated by an accurate picture of the worm drawn by the eminent Italian naturalist Paolo Panceri. The drawing is that of a gongylonema without doubt. Thus was established in Italy also, after a lapse of sixty years, the presence of Gonylonema in man. Professor Ward, on receipt of my paper, at once kindly wrote: "I was intensely interested in your explanation of the case of Pane. You have offered the most likely solution of his problematic *Filaria labialis*. The drawings by Panceri, which I had not seen, leave very little doubt in my mind that your interpretation is correct." But, no doubt the Saint Thomases of our day might quibble about the inadequacy of a drawing as scientific evidence; therefore, I decided to go back to Italy to look for Gongylonema in man, or at least in the domestic



Pane's "*Filaria labialis*," a *Gongylonema*, probably *G. pulchrum*. From the original drawing by Paolo Panceri, 1864.

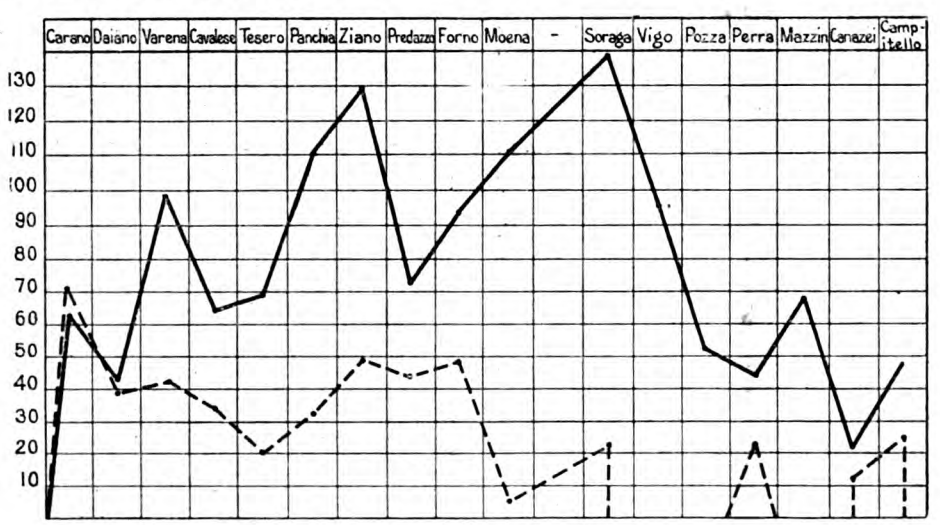
animals living in close touch with him. This I did a few weeks ago with Dr. Baylis who will tell you how we found Gongylonema, and abundantly, in the sheep, goats, oxen and swine of the Trentino and Romagna.

My recent epidemiological researches in Italy were carried out chiefly in the Trentino where I found strong support and valuable help in my friend, Dr. Antonio Ciurcentlar, recently chief medical officer of the Province; who accompanied me in all my excursions, save one to the district of Bolzano, where I went with Dr. Weiss, the present chief medical officer of the Trentino.

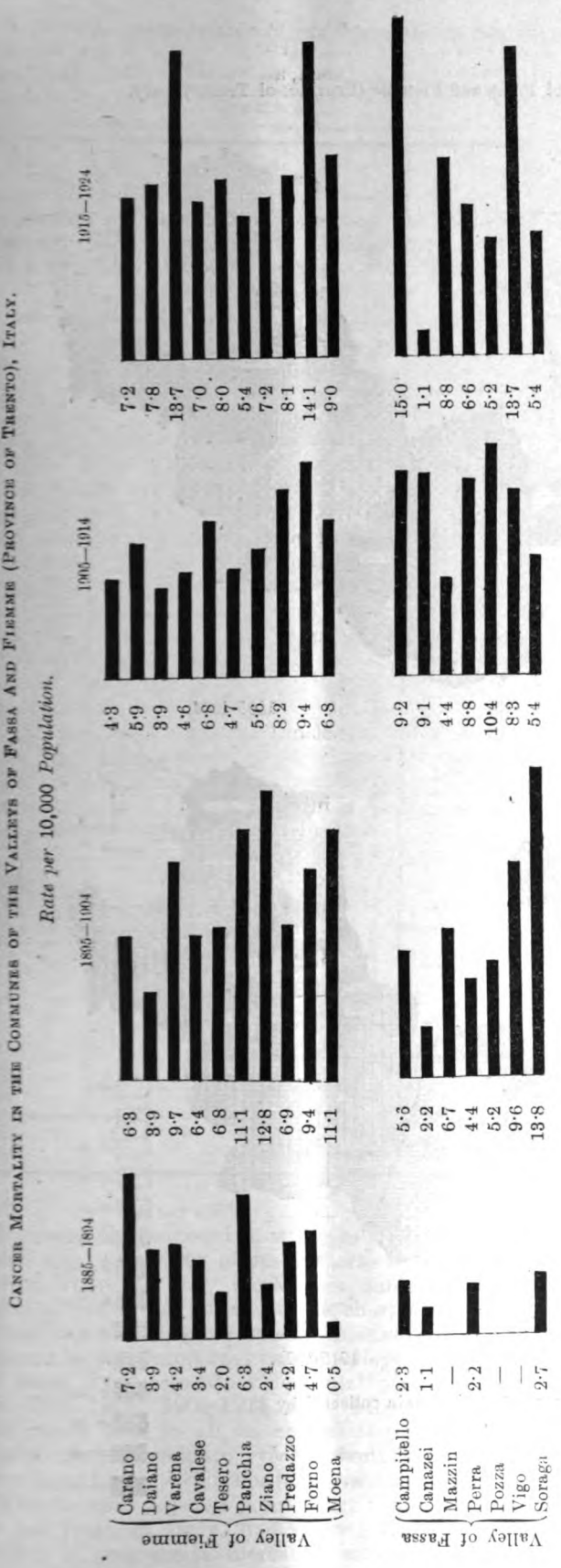
Of course I can mention only a few of the observations and these very briefly.

Whilst at Rovereto, on October 8, we met Dr. Mezzena who for twenty-five years had been district medical officer of Cavalese, a district comprising the two charming valleys of Fiemme and Fassa. Dr. Mezzena told us he had noticed that cancer was far more prevalent in the villages placed along the middle portion of the Fiemme valley. Indeed, with regard to frequency of incidence, the disease described a curve which, beginning to rise about Drina, Carano and Varena, reached a maximum between Cavalese and Predazzo, to decline rapidly at about the junction of the Fiemme valley with that of Fassa. The disease was practically unknown then in the Fassa valley beyond Mœna and Vigo. He could not say whether these conditions still prevailed now because he had left the district of Cavalese fifteen years ago.

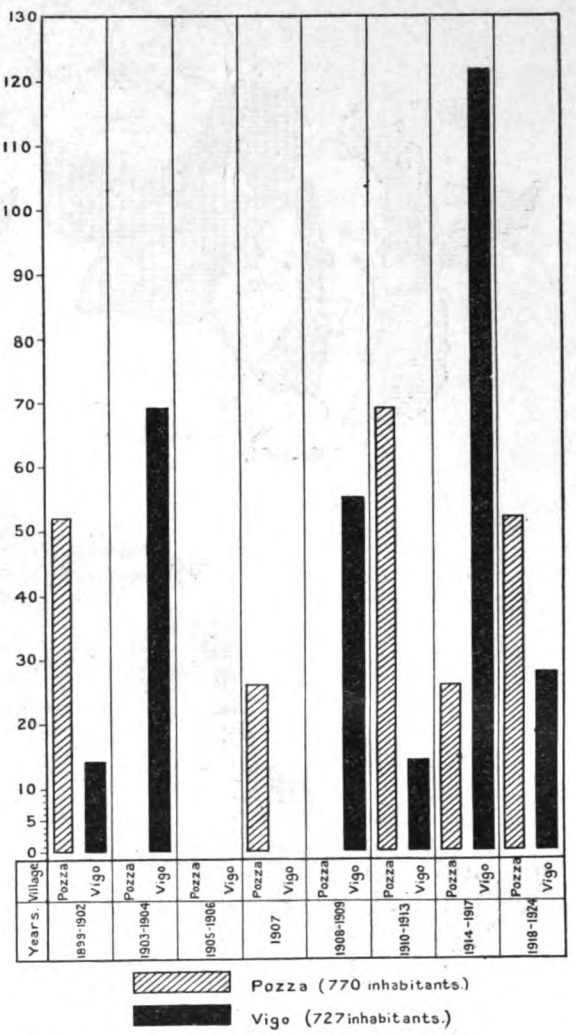
Six days later, we went to Cavalese and there were met by the district medical officer, Dr. Luigi Cosco Mazzuca, a bright, intelligent, well read Calabrian. He told us that, as stated by Dr. Mezzena, cancer was still very common in the Fiemme valley. Never elsewhere had he seen so many cases. The disease now seemed to be especially rife at Castello, Molina, Carano, Daiano, Varena, Cavalese, it continued with like frequency along Tesero, Ziano, Panchia and



Cancer Mortality in the Communes of the Valleys of Fiemme and Fassa (Trentino).
Rate per 10,000 Population.
..... Cancer deaths 1885-1894.
——— ,, ,, 1895-1904.



Predazzo, thence becoming less marked, but, contrary to Dr. Mezzena's earlier observations, cancer had now appeared also in the Fassa valley where it seemed to be extending and increasing. When Dr. Mazzuca first came to this district, not only was he greatly impressed by the number of cases, but was surprised to find so little cancer of the lip in a cancer-region where men were inveterate pipe smokers. With regard to site-incidence, cancer here was pre-eminently a disease of the stomach and more especially of the cardiac portion. In one single day he had been able to diagnose no less

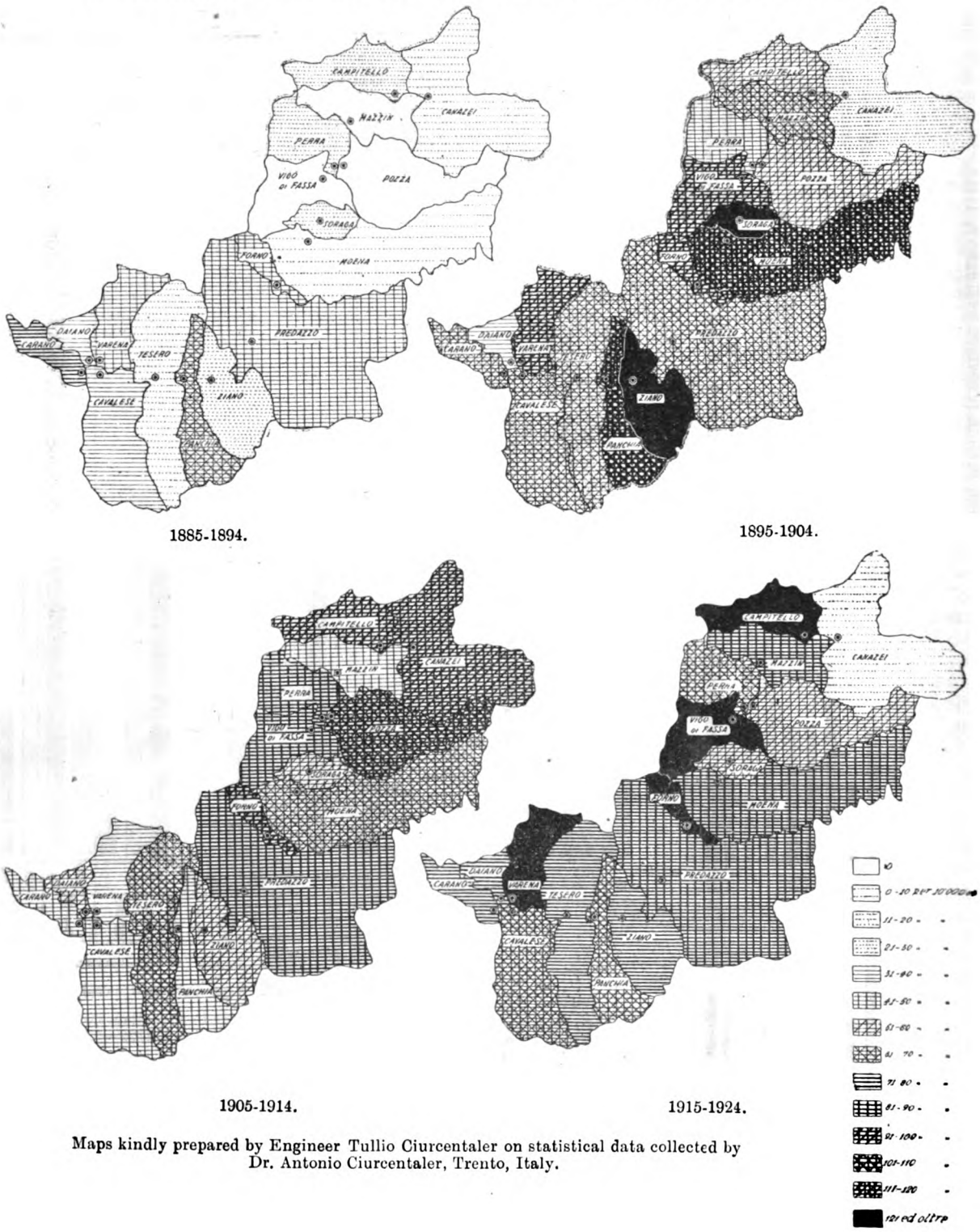


Alternating Cancer Mortality in the villages of Pozza and Vigo in the valley of Fassa, 1899—1924.

than three of the latter cases. Notwithstanding numerous instances of pyloric ulcer, he was surprised to find so few of pyloric cancer, a form frequently met with in other parts of Italy. In women he had seen uterine cancer, but rarely cancer of the breast.

The examination of the death registers of this district, kindly undertaken by Dr. Ciurcentaler who commenced with the year 1885, previous to Dr. Mezzena's tenure of office, yielded very interesting data.

Cancer Mortality in the Communes of the Valleys of Fassa and Fiemme (Province of Trento) Italy.



1885-1894. 1895-1904.

1905-1914. 1915-1924.

Maps kindly prepared by Engineer Tullio Ciurcentaler on statistical data collected by Dr. Antonio Ciurcentaler, Trento, Italy.

CANCER MORTALITY IN THE COMMUNES OF THE VALLEYS OF FASSA AND FIEMME (TRENTINO), 1885–1924.

	VALLEY OF FASSA. Communes								VALLEY OF FIEMME. Communes										
	874 Canazei	448 Mazzin	531 Campitello	450 Perra	770 Pozza	727 Vigo	361 Soraga	Total	1891 Moena	210 Forno	3,488 Predazzo	1,243 Ziano	630 Panchia	2,500 Tesero	3,265 Cavalese	721 Varena	502 Daiano	829 Carano	Total
1885	—		—	—	—	—	—	—	—	—	—	—	2	—	3	—	—	—	5
1886	—	—	—	—	—	—	—	—	—	—	2	1	—	—	1	—	—	2	6
1887	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	—	—	—	3
1888	1	—	—	—	—	—	—	1	—	—	3	—	—	1	1	—	—	1	6
1889	—	—	—	—	—	—	—	—	—	—	1	—	—	1	1	—	—	—	3
1890	—	—	—	1	—	—	—	1	—	—	2	—	1	—	—	—	—	2	5
1891	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	1	3
1892	—	—	—	—	—	—	—	—	—	—	1	—	1	1	1	—	1	—	5
1893	—	—	—	—	—	—	—	—	—	—	2	1	—	—	1	—	—	—	4
1894	—	—	1	—	—	—	1	2	1	1	1	—	—	1	1	3	1	—	9
1895	—	1	—	—	—	—	1	2	2	—	2	—	—	1	2	—	—	1	8
1896	—	—	—	—	—	—	—	—	4	1	1	3	—	—	2	2	1	1	15
1897	—	1	—	—	—	1	2	4	—	—	3	2	—	—	3	1	—	1	10
1898	—	—	—	—	—	—	—	—	3	—	2	1	1	1	2	—	—	—	10
1899	—	—	—	—	2	—	—	2	3	—	5	3	1	1	4	1	—	1	19
1900	1	—	—	—	1	—	1	3	1	1	1	1	2	2	2	—	—	1	11
1901	—	—	2	2	—	1	—	5	—	—	2	2	—	2	—	2	—	—	8
1902	1	—	—	—	1	—	—	2	2	—	2	1	—	3	1	1	1	—	11
1903	1	—	1	—	—	3	—	5	2	—	1	1	1	4	4	—	—	—	13
1904	—	—	1	—	—	2	—	3	4	—	5	2	—	2	1	—	—	—	14
1905	—	—	2	—	—	—	1	3	1	1	6	1	—	2	—	—	—	—	11
1906	1	1	—	—	—	—	—	2	3	—	—	1	—	1	4	—	—	—	9
1907	3	—	—	—	2	—	1	6	2	—	2	1	—	1	1	1	1	—	9
1908	—	1	—	—	—	2	—	3	1	—	4	2	—	2	1	—	—	—	0
1909	—	—	—	—	—	2	—	2	1	—	2	—	—	1	—	—	—	—	4
1910	2	—	—	—	4	—	—	6	1	1	5	—	—	3	1	1	—	—	12
1911	—	—	1	2	1	1	—	5	1	—	1	1	—	2	1	—	—	1	7
1912	1	—	1	—	2	—	—	4	2	—	5	—	1	3	2	—	1	1	15
1913	—	—	1	—	—	—	—	1	1	—	3	—	1	—	4	—	—	1	10
1914	—	—	—	—	1	1	—	2	—	—	4	1	—	2	1	—	1	1	10
1915	1	1	—	—	—	3	—	5	—	—	1	—	1	—	—	—	—	—	2
1916	—	—	—	—	—	3	—	3	2	—	2	2	—	1	2	—	—	—	9
1917	—	—	—	—	—	1	—	1	4	1	4	1	—	3	—	1	—	—	14
1918	—	—	1	1	2	—	—	4	1	1	5	—	—	1	3	1	—	—	12
1919	—	1	—	—	—	1	—	2	—	—	5	2	1	2	1	2	1	—	14
1920	—	—	3	—	—	—	—	3	2	—	6	1	—	—	3	—	2	2	16
1921	—	—	—	—	—	—	2	2	2	1	3	1	—	2	2	—	2	1	14
1922	—	1	1	—	1	—	—	3	3	—	5	1	—	—	5	2	—	2	18
1923	—	1	1	1	1	1	—	5	3	—	2	1	—	—	2	3	—	1	12
1924	—	—	1	—	1	—	—	2	—	—	—	1	1	1	4	1	—	—	8
Total	17	12	8	7	19	22	19	92	52	8	102	36	14	48	69	22	12	21	384

It showed that cancer is distributed very unequally, that it may spread to places hitherto immune, and that its frequency may increase or diminish in the course of years. A glance at the charts and maps representing the distribution and relative prevalence of cancer in the Communes of the valleys of Fiemme and Fassa during the four decennial periods 1885-1894, 1895-1904, 1905-1914 and 1915-1924 shows most clearly that in all its epidemiological features —distribution, prevalence, yearly fluctuations, &c.— cancer is strikingly like other infective diseases.

In my London paper, I pointed out that Professors Foa and Testi, in Italy, had noticed that notwithstanding its progressive increase, cancer exhibits in its incidence notable fluctuations from year to year. The chart on p. 51 shows a remarkable alternation in the incidence of cancer in the two neighbouring villages of Pozza and Vigo. These two villages are hardly a mile apart and have an almost equal number of inhabitants. Similar alternations in neighbouring villages have been repeatedly noticed in the case of typhoid fever, diphtheria and pneumonia.

There are other epidemiological facts to which I should like to draw your attention, such as seasonal incidence for instance, but, so far, my information is not definite enough. Drs. Samuel and W. Soltau Fenwick in their book on "Cancer and other Tumours of the Stomach," London, 1902, say "we are strongly

of opinion that carcinoma obeys certain laws of epidemiology, like enteric fever, acute rheumatism and other infective diseases, and is, consequently, more rife at certain seasons than others." They point out that the usual duration of gastric cancer varies from nine to twelve months, that in 60 per cent. of cases it commences between September and February, and that in over 60 per cent of cases death takes place between June and November. Long before, both Virchow and d'Espine had noticed that persons affected with malignant disease die more frequently in the summer than in the winter.

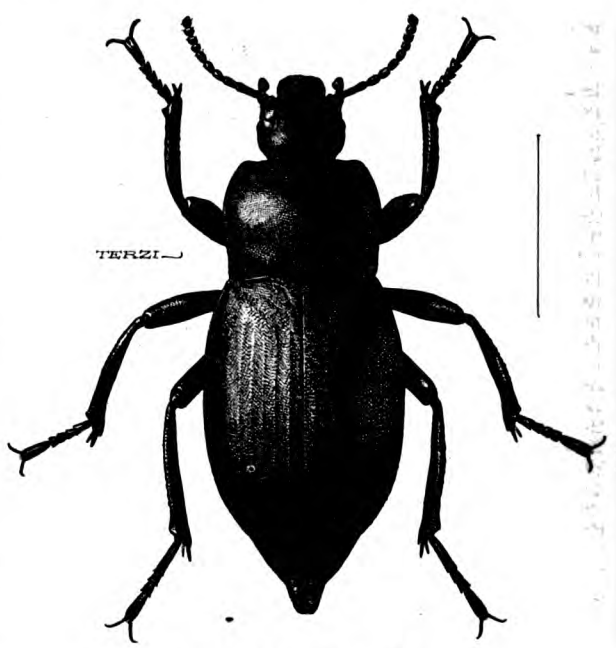
As regards the site incidence of cancer, in the valleys of Fassa and Fiemme we find everywhere a great prevalence of gastric and œsophageal cases. Mammary cancer is rare. In certain communes, such as Tesero, Ziano, Predazzo, cancer of the uterus is somewhat common; in others, such as Daiano, Panchia, Forno, Campitello, it has never occurred during the forty years under consideration.

The thickly wooded valley of Fiemme, prosperous on account of its timber wealth, is inhabited by a strong, healthy, sober, hard-working population. The Fassa valley, more alpine in nature, has poorer, less stable inhabitants. The food of these people differs greatly from that of the Icelanders. Here milk, butter and cheese also abound, because cattle and goats are kept in large numbers, but fish and meat enter far less into the ordinary diet, whilst vegetables and fruit, so scarce in Iceland, here form the bulk of the food. The most common are cabbage and sauerkraut, tomatoes, eggplant, vegetable-marrow, pumpkin, onions, carrots, peas, beans, cauliflower, spinach, lettuce, endive, celery, mushrooms, apples, pears, plums, cherries, figs, grapes, mulberries, peaches, muskmelons, walnuts, filberts, chestnuts. Cereals largely compose the daily ration, especially rice, macaroni and Indian corn, of which they make a mush well known under the name of polenta. On account of their great daily use of polenta, the people of this part of Italy have been nicknamed "polenta-eaters," but Dr. Probizer, of Rovereto, proudly reminded me that the "polenta-eaters" had tunnelled the Alps. Rye bread is practically unknown, whilst white leavened bread is in universal use. Pork is often eaten, especially in sausage form, and wine is the common table drink. Dr. Hepperger chief surgeon in the hospital of Bolzano looked upon wine as the principal cause of cancer and said the disease seemed to be more prevalent in the wine-producing districts.

At Cembra, a cluster of white houses amid chestnut groves, we met Dr. Arturo Vielmeti, district medical officer, who had practised in the valley for about fifteen years. He told us that cancer is exceedingly prevalent there. Nine out of ten were gastric cases and the growth was located most frequently in the cardiac portion. Cancer of womb or breast was very rare. He remembered only one mammary case which was operated, but soon afterwards the patient had died from spinal metastasis, which had caused painful paraplegia. Seven months before, a miller had succumbed to gastric carcinoma and, in the previous year, at Valda, Dr. Vielmeti had attended two cases in the same house, both of whom had died of gastric carcinoma with metastases, one in liver, the other in pleura. He told us we should find at Grumes a small inn where cockroaches were so numerous that often, in broad daylight, he had seen them saucily scamper over the table on which he was writing his prescriptions. The husband of the proprietress had died, not long ago, of gastric carcinoma at the age of thirty-eight.

Passing through Grumes, we stopped at the "Nuova Italia" inn where the small greyish-yellow cockroaches (*Blattella germanica*) abounded. They swarmed around the cooking stove whereon seethed a savoury and appetizing stew.

At Pergine, Dr. Quirino Morelli, who had practised for over twenty-eight years in the district, told us that he had seen cases more or less in every part, chiefly in the Fersina Valley and more especially at Sant 'Orsola and Fierozzo, less at Palù and none at



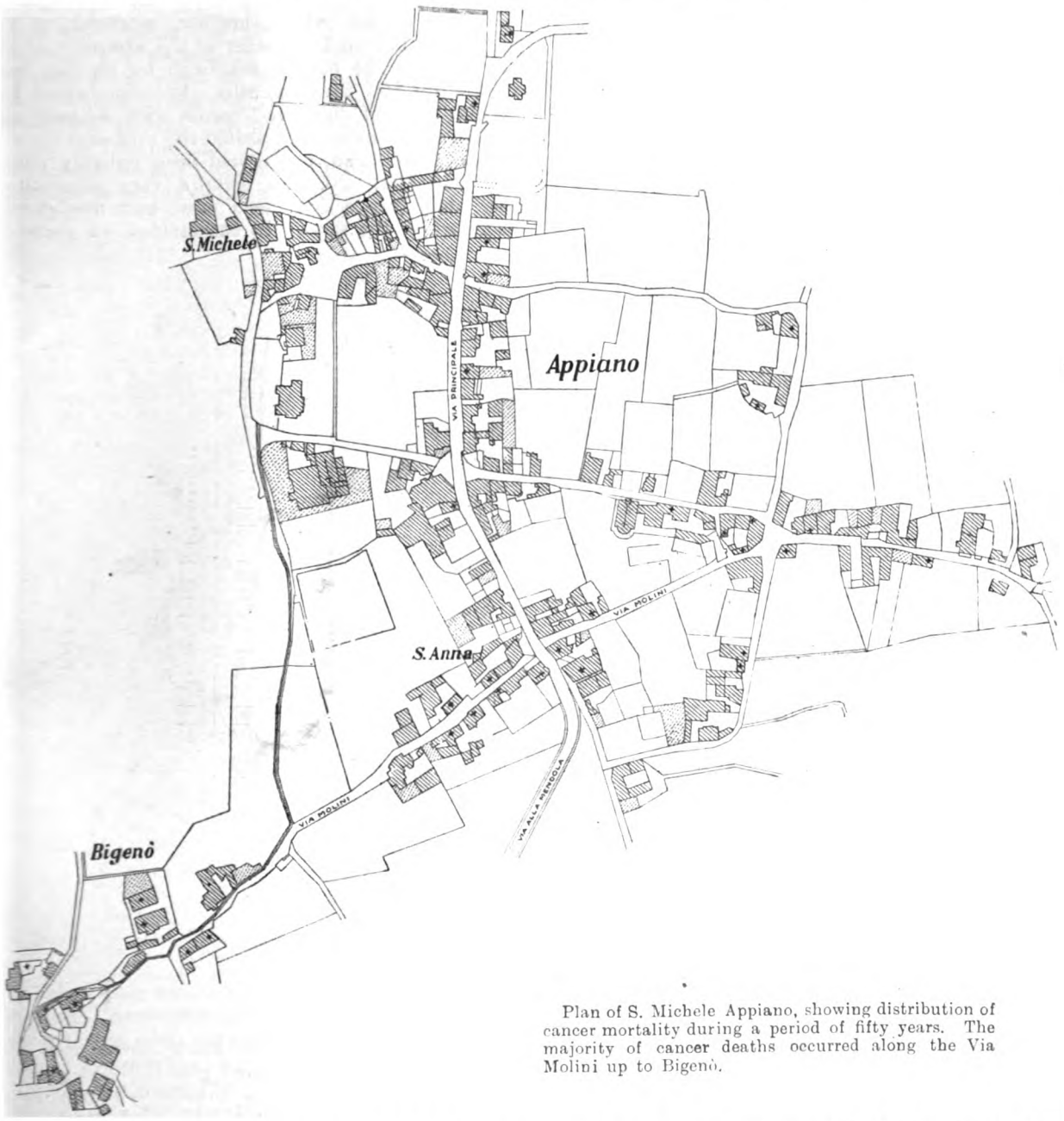
Blaps lethifera Marsh ♂

Frassilongo proper, but, curiously enough, several at Rovida which is a "frazione" or tiny dependency of the village of Frassilongo. At Portolo of Canezza, he had known a man and wife who had died of cancer, both on the same day. The man, Giacomo Roner, had died at home of cancer of the stomach, whilst his wife, Monica, succumbed to cancer of the thyroid at the Levico hospital. Both had been ailing for about ten months. The wife had had a small nodular goitre for over thirty years. In her case the cancerous degeneration of the goitre had begun suddenly in April, 1924. She had complained of violent pains about the thyroid region and, more recently, of difficulty of deglutition and respiration.

We drove to Portolo and visited the Roner's house. It was well built and clean, the walls had been distempered quite recently. The Roner family now consisted of three youths and five maidens. One of

the boys had been operated upon for appendicitis. The others seemed well and robust, save one of the girls who was somewhat anæmic. They told us that at one time cockroaches (which they called Sbovi) infested the house, but that now they seldom saw any. They often found "worms" (Tenebrio) in the meal-chest. Whilst we were examining the kitchen, an affrighted mouse scuttled across the room.

We visited the cellars which were full of barrels, containing the new wine and of great heaps of potatoes. There were no cockroaches here, but beneath a great stack of dried leaves and rubbish, against the stable and pig-sty wall, on raking the damp soil, we found numerous cellar-beetles of two kinds (*Blaps lethifera* and *B. mucronata*) together with their larvæ; the soft, fat, incurved maggots of a Cetonia also, as well as innumerable wood-lice (*Oniscus*, *Armadillidium*) which rolled themselves most obligingly into pills. They were once, may-be still are, deemed a "remedy" for cancer.



Plan of S. Michele Appiano, showing distribution of cancer mortality during a period of fifty years. The majority of cancer deaths occurred along the Via Molini up to Bigenò.

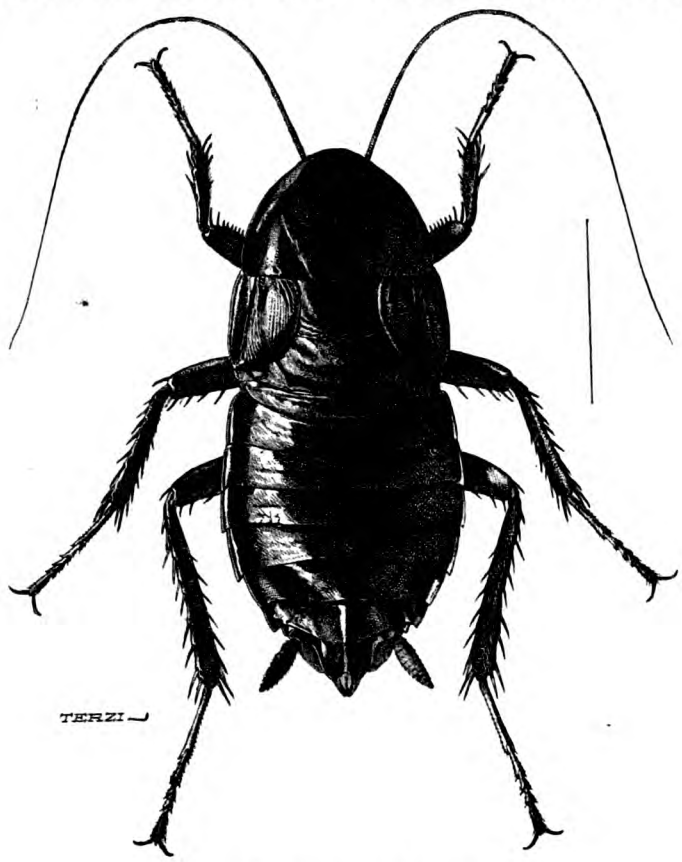
The case just mentioned of husband and wife dying of cancer both on the same day, is not the only one to my knowledge, but if death does not strike down wedded patients often at the same hour, the cases of simultaneous cancer in husband and wife, "cancer à deux" as it has been termed in France, are only too common: medical literature abounds in such. This fact often has been adduced as a proof of contagion,

but erroneously, since many other facts prove, in the most unmistakable way, the non-contagiousness of cancer. The whole epidemiology of cancer, such as I know and interpret it, clearly shows that we have before us an endemic infectious disease transmitted by intermediary agents closely linked with the dwelling or with other local conditions. We see it attack husband and wife, parent and offspring, servants and domestic animals all living beneath the same roof. We see it strike, either several generations inhabiting the same house, or several families succeeding one another in the same dwelling.

At Strigno, Dr. Lino Floriani, for the last twenty years district medical officer, told us that cancer was scarce in his district. He had seen epithelioma of the thyroid, but cancer was rare, whilst, on the other hand, goitre was very prevalent. We were in a goitrous region; in the schools no less than 50 per cent. of the girls and 40 to 45 per cent. of the boys were goitrous. He had seen goitre in animals and had even removed it from dogs by operation. He remembered a woman, aged 63, who had died of carcinoma of the stomach in 1920 after about one year's illness; she had lived in a miller's house where, besides the mill, there was a bakery. Not long after her death, the husband began to complain of gastric disorders and subsequently developed a malignant growth which seemed to involve the greater part of his stomach.

At Levico we had a talk with Dr. Luigi Depretis, who told us that practising in the district of Rimini in Romagna, he had noticed that cancer was especially common amongst millers there, but the reason why he could not explain. The millers, necessarily, lived along streams.

Dr. Guido Rippa, at Scurelle near Strigno, took us to see a case of carcinoma of the cardia in a miller 69 years of age whose brother, working in the same mill, had died of cancer of the stomach at the age of 35. The patient examined by us had been ill for the last three months; he complained less of pain than of digestive troubles such as feeling of weight after meals. We visited the mill and found it exceptionally clean, but it had been entirely rebuilt after the war. *Blatta orientalis*, very common at one time, was seldom seen now, but meal-worms occurred in the flour. In the stables we found no Blaps, but the mill-people knew them well and assured us that they occurred plentifully in summer.



Blatta orientalis Fol. ♀

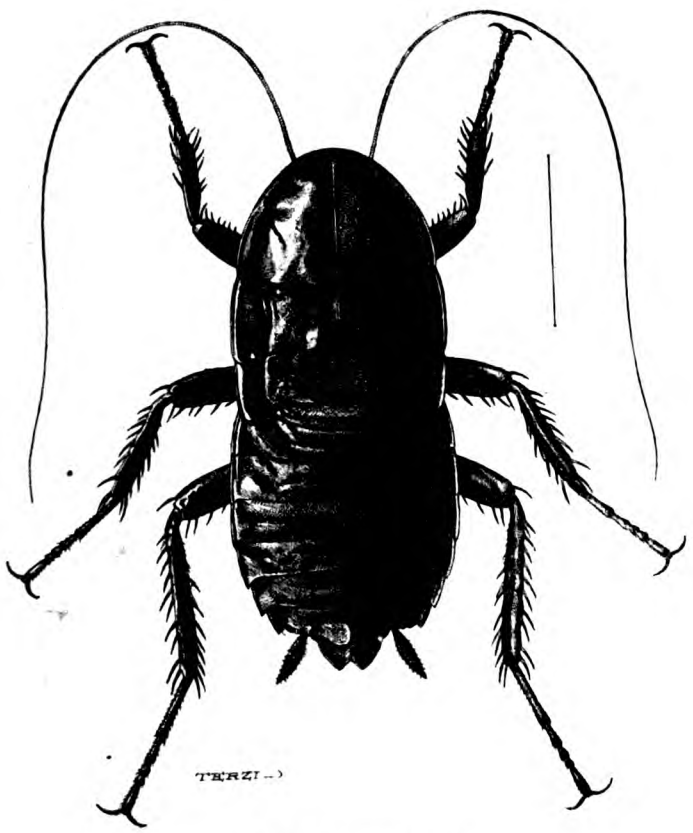
Leaving the mill, we went opposite to see the house of a woman, aged 50, who had died recently of cancer of the pylorus. In this case there had been no premonitory signs. Indeed, until two days before death, the patient had felt no need of going to a doctor, then suddenly hæmatemesis occurred and I was told that she had vomited no less than six pints of pure blood.

At San Michele d'Appiano, near Bolzano, where we motored with Dr. Zieglauer, district medical officer of Bolzano, Dr. Weirorther told us that the great majority

of cancer cases seen by him in San Michele, had occurred in houses situated along the Mühlbach, or Mill-torrent, a stream once open, which now has been canalized and covered. Six to ten years back all these houses had furnished cases of cancer of the alimentary tract, more especially the œsophagus and the stomach. Fifteen or more years ago there were several mills along the Mühlbach, now only one remained. We walked up Via Mulino to a cluster of houses at a place on the mountain side called Piganò (Bigenò by the Germans) where several cases had occurred of late. Dr. Weirorther remembered at least six in this locality. The mill still standing was a very small one and little meal was kept there. The miller, his wife and child were the only occupants, they looked pale and sickly, but there was no history of cancer. The woman assured us that there were no cockroaches in the building and, indeed, we were unable to find any.

Almost opposite the mill were two houses, both of which had furnished cancer cases. One of these was inhabited by a grocer whose shop, on the ground floor, contained oil, candles, sugar and sacks of rice, maize meal, wheat flour and other goods. The house was infested by mice and by two kinds of cockroaches: Schwaben (*Blatta orientalis*) and Russen (*Blattella germanica*). Two cancer cases had occurred in this house. The house adjoining also had yielded one or two cases, but we were unable to examine it.

Considering the great interest of this observation—cancer limited almost entirely to one single street of a village—I begged Dr. Ciurcentaler to visit San Michele d'Appiano in order to verify Dr. Weirorther's assertions and our own observations, also to obtain definite official confirmation thereof. This very morning Professor Calmette has handed me Dr. Ciurcentaler's answer addressed to me here. In it he informs me that San Michele d'Appiano has a population of 1,957 inhabitants; that during the last forty years thirty-four deaths from cancer have been registered, that twenty-six of these occurred in the Via Mulino and at Bigenò along the Mühlbach. Bigenò has 235 inhabitants from among which eight deaths from cancer were registered, that is to say, nearly one quarter of the total number of the cancer deaths. Of all mentioned cases eighteen occurred in men, sixteen in women. With regard to site-incidence eighteen were stomach, three œsophagus, one tongue, one intestine, one larynx, one thyroid, one breast, one uterus, five, organ not specified. Thus you see that the official data, most carefully collected by Dr. Ciurcentaler, fully confirm Dr. Weirorther's statements that most cases had occurred along the mill torrent.



Blatta orientalis nymph.

From San Michele we drove on to Caldaro, a district famous for its fruit crops, passing many an orchard ablaze with apples of deep red and tender green. I knew the loveliness of the apple blossom, but I had no idea that the fruiting branch could appeal so strongly to one's sense of beauty.

At Caldaro, whilst lunching at the "Moonshine Inn" we were joined by the local health officer,

Dr. Carl Konzert, who led us to the Via Goldglass to see a carpenter who had cancer of the cardia. The disease had started about three months before with pyrosis, soon followed by dysphagia and regurgitation of food. In the patient's house we found the two kinds of cockroach (*Blatta orientalis* and *Blattella germanica*) which in this region are usually found side by side though not fraternizing.

On leaving the poor, starved, careworn carpenter, we went to inspect a house in "frazione" Mezzavilla where, some years ago, Dr. Konzert had attended a grain-chandler, aged 32, who had cancer of the tonsils. In the adjoining house another man of 60 had died of cancer of the larynx and in a house opposite, a butcher had died likewise from precisely the same condition—cancer of the larynx.

Frequently, in the course of my researches, I have had the opportunity of observing in neighbouring houses, or in a single house inhabited by different families, several cases of cancer, in all, or nearly all, of which the neoplasm occupied either the stomach, or the liver, or the breast, uterus, œsophagus, or maybe the larynx, as in the example just mentioned. Medical literature affords many such examples of homotypic transmission which have been brought forward in support of the hereditary theory of cancer. I wish to point out that they have another, a true and far more important, value—an epidemiological one. At first sight the homotypic transmission of cancer in successive generations of a same family might lead one to consider the theory of hereditary transmission plausible, but how can one apply this same theory to the exactly similar pathological conditions occurring at the same time in persons of different stock inhabiting the same house, or in total strangers occupying neighbouring houses?

It seems to me that the question of the hereditary transmission of cancer is exactly on a par with that of tuberculosis. Both diseases, according to circumstances, may manifest themselves in grandparent and grandchild, or in uncle and nephew, often leaving the direct child or parent immune and we see both diseases appear in the descendants, either in the same or in different organs. In tuberculosis, cases of homotypic transmission in the same family have been looked upon, not only as evidence of hereditary transmission of the disease, but, further, as indicating the transmission of a particular susceptibility or predisposition of the organ affected (lung or kidney, as the case might be). But I believe, and laboratory experiments bear me out, that the selection of the organ has little to do with the host, but is made by the parasite, because, thank God, it is not a greater predisposition to the disease, but a greater resistance against it, that we inherit. Disease in the parent tends to produce immunity in the child. It is certainly the parasite which, accustomed to a certain organ, makes invariably for that same organ in its successive transmissions to new hosts. The whole science of parasitology teems with proof of this. To my mind, therefore, it is by infection that we must explain the very striking fact of the homotypic transmission of cancer to persons of different stock inhabiting the same house or the immediate neighbourhood of a cancer focus.

The hereditary theory of cancer, like that of tuberculosis or leprosy, is a dying theory which Miss Sly has endeavoured to resuscitate by means of data certainly exact and carefully collected, but ignoring important factors.[1] For my part, I do not understand this strange tendency to invoke heredity at all costs, to explain the genesis of diseases the true cause of which has, hitherto, escaped us. We all remember that even echinococcosis, filarial elephantiasis and scabies were at one time seriously believed to be hereditary diseases!

Now, let me lay before you a remarkable observation which I owe to the great interest Dr. Ciurcentaler has taken in my cancer researches. When I left the Trentino, this able, learned and experienced colleague promised that he would endeavour to continue and extend the work we had begun together in his province.

On November 21 last, he wrote: "I have discovered in Villa Lagarina important epidemiological facts which confirm in every way your theory.

"Villa Lagarina has a population of 680 inhabitants, the majority well-to-do farmers. Charmingly situated on a gentle slope, near Mount Stivo, in the valley of the Adige, with its well-built houses, clean streets and pleasant squares, it has the appearance of a small pleasure town. Certainly, enchased in verdure, gleaming in the sunshine, it is a perfect gem.

"Well, the local physician, Dr. Scrinzi, to whom I explained your views concerning cancer, recalling the past experience of over forty years during which he has practised in Villa Lagarina, pointed out that, strange to relate, of the whole village, one street alone—Via Damiano Chiesa—had been smitten almost exclusively!

"Availing myself of this surprising statement, at once I instituted the most careful inquiries and, in the first place, I personally examined the local death registers, jotting down all deaths due to cancer during the last fifty years. The data thus collected gave me the fullest official confirmation of Dr. Scrinzi's statement. I can say that even during the ten years prior to the period of his practice, I could find hardly any cancer death occurring outside the street indicated by him.

"Then I procured a plan of the village from the Government Map Office in Trento, had it enlarged four times the diameter and marked with a cross each single case of death from cancer exactly where it had occurred. The list and map which I send you herewith tell their own tale. Finally, I visited and examined each marked house, collecting all vermin (*blattæ*, *blaps*, &c.), found in rooms as well as stables and sent the material to Dr. Baylis at the British Museum, as per your instructions.

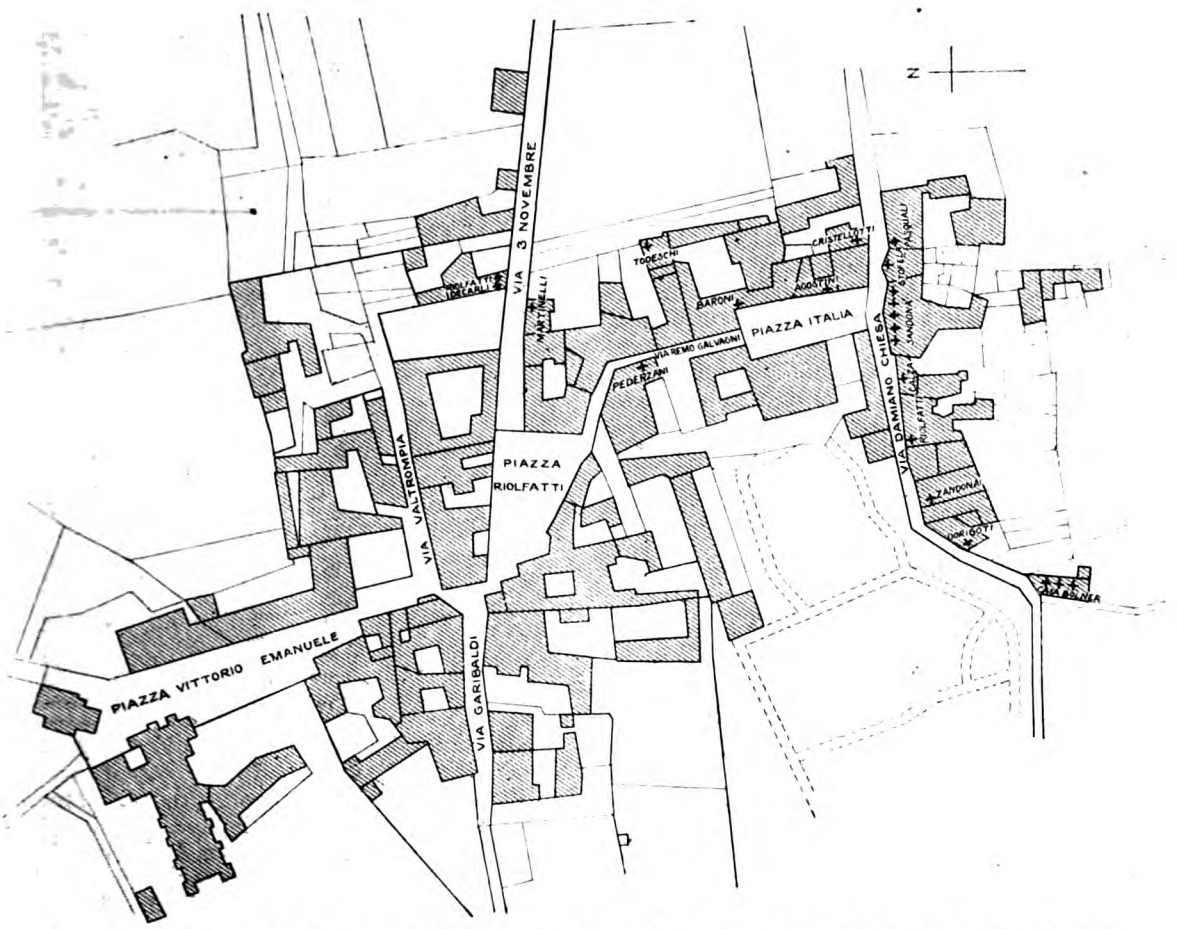
"Of the twenty-two cases marked on the plan, you will notice that no less than fifteen occurred in Via Damiano Chiesa and two in the adjoining Piazza

[1] In *Journ. of Cancer Research*, July, 1924, Sly states that in spite of constant efforts to rule out all vermin and parasites, there have been periods when the stock has shown both tapeworms and nematodes.

Italia, whilst the remaining five occurred not far off, three in Via Tre Novembre and two in Via Remo Galvagni. Thus, seventeen of the twenty-two cases occurred in fifteen families the members of which, together with those of other immune families, formed the population of Via Damiano Chiesa and Piazza Italia, numbering in all 121 persons. In the family B. there occurred three cases and in the family S. no less than five, all women. Two of the cancer deaths which occurred in Via Damiano Chiesa were of persons who had come from abroad: one, a war refugee named Stofella, who came to Villa Lagarina in perfect health and remained so during the four subsequent years; the other, Pasquali, a native who had been abroad practically all his life, returning home in advanced age, when he soon contracted cancer and died.

"Of the twenty-two cases twelve occurred in males, ten in females. With regard to site incidence, no less than seventeen, or over 77 per cent., were gastric carcinomata, ten in males, seven in females. There were besides two cases of oral cancer in men and two of the breast, with one of the uterus in women. The youngest case was that of woman 38 years of age, the oldest that of a woman aged 81. The average age-incidence being 65½."

In examining the plan of Villa Lagarina just received from Dr. Ciurcentaler, you will notice that all the crosses marked in Via Damiano Chiesa, save one, are on the right side of the road, this singularity is no doubt due to the paucity of inhabitable buildings on the left side. However, I take the opportunity of drawing your attention to the fact that similar peculiarities in the topographical distribution of cancer have been noticed already on several occasions. Thus, Dr. Mason has shown that in the district of Leamington,



Plan of Villa Lagarina in the Valley of the Adige (Trentino), Italy, showing cancer mortality, during a period of fifty years, restricted almost exclusively to one street—the Via Damiano Chiesa.

in England, cancer was quite common in houses situated in certain rows or upon one side of a row, while in other streets it was conspicuous by its absence. He stated that about 17 per cent. of these cancer houses were placed at the end or at the corner of a street, were of old construction, and were built upon a porous subsoil. I have no doubt that from a careful study of these peculiarities of distribution will emerge the data enabling us to grasp the ætiology of cancer. It is by such data of topographical distribution that, in the spring of 1903,

without having been to Africa or having seen a specimen of the fly. I was able to incriminate the dusky tsetse-fly (*Glossina palpalis*) as the carrier of sleeping sickness, and maintain, against Manson himself, that the Gambia fever trypanosome, discovered by Castellani in the cerebrospinal fluid of sleeping sickness cases, was the true cause of the disease. Meanwhile, allow me to remind you that the peculiar limitation of cancer to certain restricted areas, to certain streets, to one single street, one side only of a street. or to a single house or apartment, are strikingly paralleled in the epidemiology of yellow fever, leprosy and plague. They seemed indeed mysterious at one time, those streets, those houses, those ground-floor rooms, where the dreaded "Yellow Jack" struck down his victims. They are thoroughly explained to-day by the peculiar distribution and habits of the silver-striped tiger-mosquito—the *Aedes calopus*—which inoculates the germs of yellow fever.

The several observations which I have laid before you, show clearly, I believe, that cancer has a very unequal geographical and topographical distribution. Whilst excessively prevalent in certain localities, it is rare, or totally absent in others adjoining. Sometimes, as I have just stated, it may strike a village only, or a single street or house. When it is limited to one village, we have the so-called "cancer village," when restricted to a single house, the "cancer house." In the third edition of his book on "The Cancer Problem," Green mentions one of these fatal houses in his own district which "had ultimately to be pulled down owing to the great number of deaths from cancer which occurred in it." I myself have examined several cancer houses, villages and districts; of others I have been told or I have read in literature. They are well established realities.

Have not the pathologist and the "food expert" too lightly brushed aside facts opposing their theories? Hypotheses fail, not facts. No, the striking inequalities in the distribution and prevalence of cancer, repeatedly observed in all parts of the world, cannot be put aside with scoffs or by juggling with figures; they are obviously due to peculiar local circumstances which we are beginning now to understand.

"Let us hope," said the Director of the Imperial Cancer Research Fund in London not long ago, "let us hope that the dangers of 'cancer-houses' will cease alike to alarm the public and divert the energies of investigators from fruitful lines of inquiry." May I, in turn, venture to express the hope that investigators will cease to worry mice, for a time at least, and turn their energies instead to researches far more fruitful on real cancer in those places where it attacks man most severely?

No less striking than the great inequality in geographical and topographical distribution of cancer is the diversity of its repartition by organ or part of body in different countries and localities. Some of these differences are well known, such are the rarity of cancer of the female breast in Japan compared with its great frequency in England; the extraordinary frequency of penile cancer in certain parts of Asia contrasting with its rarity in Europe and America; the great prevalence of primitive hepatic cancer in certain coast districts of Asia and its rarity in Europe; the commonness of cancer of the stomach in Europe, its rarity in Asia.

Differences in site-incidence just as striking are found in the various animal species; such are the great frequency of mammary cancer in she-cat and bitch, its extreme rarity in the cow; the very common occurrence of cutaneous epithelioma in the dog, its scarcity in stallion and bull; finally, the great rarity of cancer of the alimentary tract in animals as compared with its frequency in man.

How explain by means of non-parasitic theories these striking dissemblances which cancer exhibits in its distribution in different countries and places; in its repartition in different organs and parts of the body? Can we explain them satisfactorily by food theories such as the use of mustard, salt, wine, cider, roast pork, white bread, water-cress or tomato? Shall we succeed better, do you think, with arsenic, phosphorus, tobacco, coal, tar, radium or the sun's rays? Some *savants* have suggested the erect attitude of man, incestuous intercourse between some of our body cells, embryonic remains, anarchic tissue-cells, endocrine disturbances, moral and physical sufferings, lack or excess of vitamines, arthritism, melancholia, heredity, civilization, constipation; can any of these theories give us the all fulfilling answer we are seeking? Or must we turn to food preservatives, soot, paraffin, burns or blows? Can we reconcile any of these theories with the facts of distribution, site incidence and yearly fluctuation—in a word, with the natural history of the disease?

The results of my researches allow me to claim, without fear, that the name of Cancer must be written large on the tablets of parasitology. Therefore, I range myself by the side of Professor Borrel, a great and indefatigable cancer student, a member of this Institute, who turned us into the right path when he pointed out that the larval form of the thick-necked tapeworm of the cat could bring about the development of a sarcoma in the liver of rats.

The *Tænia crassicollis* or rather *T. tæniæformis* was first mentioned and figured by the physician, naturalist and poet, Francesco Redi, in his famous work on "Observations on living animals which are found within living animals," published in 1684.

Having found in the omentum of the Wau-wau, or Silvery Gibbon of Java (*Hylobates leuciscus*), the larval form of a new species of cestode presenting the features characteristic of *T. tæniæformis*, I considered it expedient to propose the creation of a new genus which might include my new species together with *T. tæniæformis*, *T. laticollis* and other tapeworms presenting a massive rostellum, the quasi-absence of neck and a strobilate larval form. For this new genus I adopted the name *Reditænia* in honour of the great Italian naturalist, while for the new species I proposed the name of *R. borreli* in homage to Borrel for the new direction he had given to cancer research.

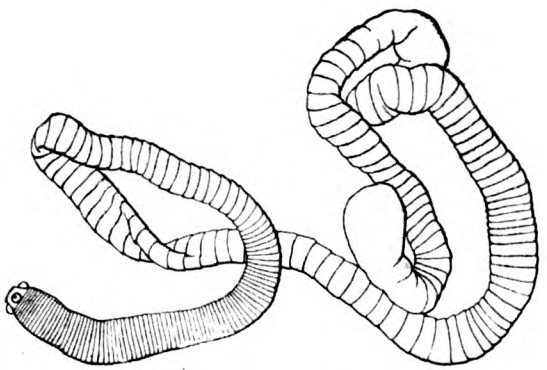
A few years later, Professor Johannes Fibiger, of



Reditænia tæniæformis as delineated by Francesco Redi in his famous "Observations on living animals which are found within living animals," Florence, 1684.



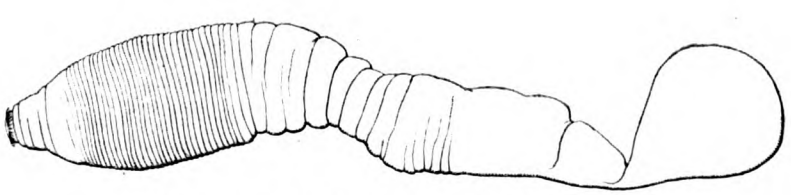
Professer A. Borrel, Director of the Bacteriological Institute of Strasbourg. A great cancer student.



Larval form of *Reditænia tæniæformis* Batsch, 1786, usually spoken of as *Cysticercus fasciolaris*.

Here, then, are two malignant neoplasms, differing in nature and site-incidence, both developed in the rat and both brought about by the agency of helminthes belonging to two different classes. The rat contracts the hepatic sarcoma by eating food contaminated by the excrement of cats containing the eggs of *Reditænia tæniæformis* and it acquires the gastric carcinoma by devouring cockroaches or other insects (*Blaps*, *Tenebrio*, *Aphodius*) harbouring the larvæ of *Gongylonema*. Two different kinds of tumour may be found in the same rat, as shown by Eiken.

One can artificially reproduce at will these two neoplasms, feeding to rats aliments containing the



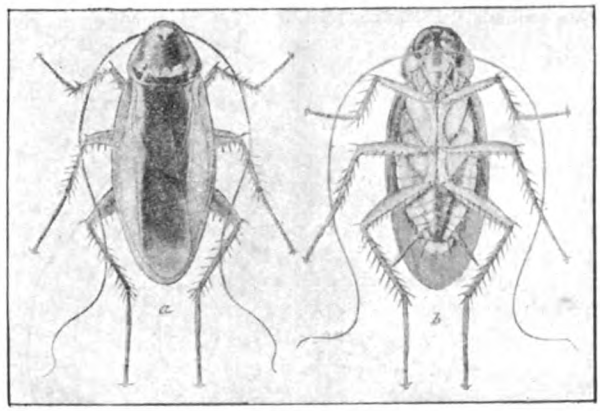
Larval form of *Reditænia borreli* Sambon, 1924.

Copenhagen, made known his remarkable researches on a carcinoma of the stomach of the rat produced by the agency of a roundworm—a *Gongylonema*. The larvæ of this worm he found coiled up spirally, just like trichinella larvæ, among the striated muscles of the Kakerlak or American cockroach (*Periplaneta americana*) infesting a Danish sugar refinery and which had been imported with raw sugar from the Danish West Indies.

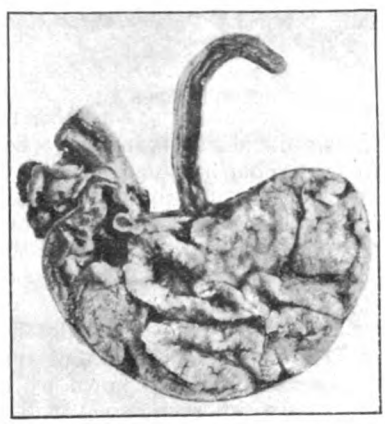


Gongylonema neoplasticum, natural size. (After Fibiger.)

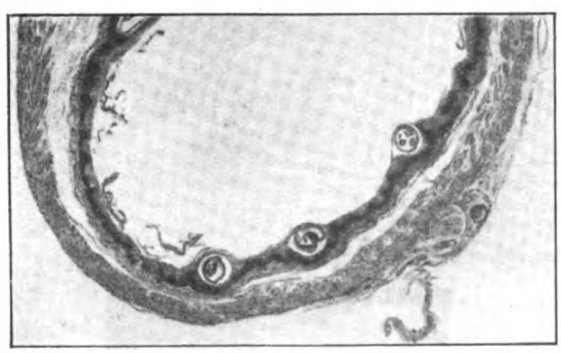
relative parasites: the larvæ of the gongylonema, if one desires to obtain the gastric carcinoma; the ova of the tapeworm if one wishes to reproduce the hepatic sarcoma. It is thus that Bullock and Curtis,



American cockroach, *Periplaneta americana* (*L*).
a dorsal aspect. *b* ventral aspect.



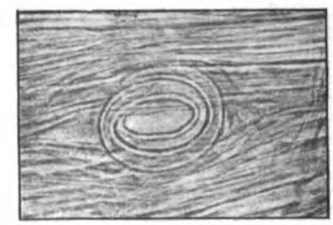
Carcinoma in stomach of rat infested by *Gongylonema*. (After Fibiger.)



Transverse section of rat's œsophagus showing *Gongylonema* in situ. (After Fibiger.)

in New York, have been able to raise more than a thousand liver sarcomata in rats. Professor Brumpt, who has just returned from the United States of America, has been kind enough to bring us here two preserved rats bearing hepatic sarcomata artificially obtained by experimental cysticercosis in the George Crocker Research Fund laboratory. Could anything be more convincing of the part which may be played by parasitism in the genesis of cancer? I am grateful to my friend Professor Brumpt for his kind thought in showing us these two remarkable specimens.

In my London paper, I pointed out that there were several forms of cancer in man, the organ-incidence and geographical distribution of which found an easy and natural interpretation in the parasitism of certain helminthes. I mentioned *Schistosoma hæmatobium*, long suspected of playing a part in the production of cancer of the urinary bladder in Egypt, and *S. mansoni*



Larva of *Gongylonema* encysted in musculature of cockroach (After Fibiger.)



Eggs of *Gongylonema*. (After Fibiger.)

which likewise, in the same country, seems to be an important factor in the genesis of rectal carcinoma. I remarked that the spined ova of these parasites often were found in the neoplasms to which they gave rise, the terminal spined ova of *S. hæmatobium* in cancer of the bladder, those with a lateral spine, characteristic of *S. mansoni*, in rectal cancer. This latter species I established in 1907, separating it from Bilharz's species with which it had been confounded and, basing myself again on epidemiological and parasitological facts, I stated, without fear of error, as is evident from my controversy on the subject with the late Professor Looss, that further researches would prove that the larval forms of the two blood-

flukes in question would be found in the liver of fresh-water snails while for each species of schistosoma would be found a specifically different intermediary host. Professor Leiper's researches in Egypt proved fully the exactness of these provisions which were not "prophecies" as some authors have called them, but the outcome simply of carefully collated epidemiological and parasitological data, open to all.

I recalled that already in 1901 Askanazy had pointed out a tiny reddish, lanceolate fluke, the *Opisthorchis felineus*, as capable of inducing cancer of the liver in man. This trematode worm, discovered in 1884 by Rivolta in cat and dog in Italy, has been



Opisthorchis felineus (Rivolta) 1885.

found since in France, Hungary, Eastern Prussia, Holland, Sweden, Russia, Siberia and Japan, not only in cat and dog, but also in fox, glutton and man. Man and animal become infested by eating raw fish, because the cercaria of this trematode encysts in the musculature and skin of several species of cyprinoid fishes, such as the roach (*Luciscus rutilus*) and the ide (*Idus idus*) which inhabit both salt and fresh waters.

Askanazy has described the lesions produced by this fluke: the congestion of the liver, the proliferation of the epithelium of the obstructed and dilated biliary canaliculi, the appearance of newly formed bile-capillaries, the proliferation of the connective tissue, the hypertrophy of the glands, the production of adenomatous and papillomatous formations as well as the cirrhosis and cancerous degeneration clearly determined by parasitic irritation. But, that which certainly demonstrates the cancer-producing agency of this tiny trematode is an epidemiological observation which has all the distinctiveness of a purposely made laboratory experiment.

It had been pointed out that cancer of the liver or gall-bladder was common among the fisherman of the Baltic shores and more especially among those of the Kurische Haff, a vast lagoon in East Prussia, between Königsberg and Memel. Dr. Rindfleisch's researches elicited the fact that the fishermen of this region were in the habit of eating raw fish during their fishing cruises, hence they were heavily infested by *Opisthorchis felineus;* their biliary ducts were crammed with hundreds and thousands of the tiny flukes. Possibly this same trematode will be found to be responsible for another small focus of primary hepatic cancer near Kolozsvar in Hungary.

Verdun and Bruyant in Tonquin found *O. felineus* in man, associated with the Chinese liver fluke (*Clonorchis sinensis*), a larger trematode also inhabiting the biliary ducts of man and certain fish-eating mammals such as the dog, cat, badger and marten. *Clonorchis sinensis*, like *Opistorchis felineus*, has, for second intermediary hosts, certain fishes, such as *Pseudorasbora parva, Leucogobio güntheri, Acheilognathus lanceolata* and *Carassius auratus* or "gold-fish," in the skin and flesh of which it lies in ambush. *C. sinensis* is widely spread among the coast-inhabitants of China, India, Indo-China and Japan and it is on account of this peculiar coastal distribution—an important epidemiological fact—that, already in 1908, Professor Ward was able to incriminate fish as the probable cause of infestation.

These two flukes are joined in China and Japan by a third trematode, the *Schistosoma japonicum*, a blood-fluke which gives rise to a grave biliary cirrhosis, long known in Japan by the name of Katayama disease from the district of Katayama where it is very prevalent and best known. According to Professor Katsurada, this bilharziosis is very common in the central provinces (Bingo, Yamanashi, Hiroshima) of Japan and especially at Saga in the Island of Kyushu. Now, from a totally different source, I learn that, in this very island of Kyushu, primary cancer of the liver is three times more frequent than in the rest of Japan. Is not this striking? Does not the coincidence with preportionate frequency of liver-fluke and liver-cancer in the same areas indicate a probable relationship of cause and effect?

The three last trematodes mentioned produce, everyone of them, biliary cirrhosis which, indeed, may be looked upon as a "pre-cancerous condition," since obviously it favours the development of hepatic carcinoma. In Japan, in China, in India (especially Madras), the connection between cirrhosis and primary hepatic cancer is well known.

I mentioned *Trichinella spiralis*, a small nematode encysted among the muscle-fibres, found by Hilton, in 1832, in a man aged 70, who had died from cancer of the penis. Hilton took the parasites for tiny cysticerci, but, three years later, James Paget, then only a student at St. Bartholmew's hospital in London, found again the encysted trichinellas in the body of an Italian, recognising that they were small cylindrical worms coiled up spirally. Wormland, demonstrator of anatomy in the same hospital, believing them to be earthy deposits only, brought a fragment of affected muscle to Professor Owen who studied the organisation of the worm and gave it the name of *Trichina spiralis*. The generic name *Trichina* being already in use for an insect, Professor Railliet changed it into that of *Trichinella*. Since Hilton's case, trichinosis and cancer frequently have been found together while the trichinella has been cited as being able to induce cancer. Quite recently Dr. Brown of Blackpool informed me of a case of cancer of the tongue in which the neoplasm had developed around a small calcified worm, possibly a trichinella.

I mentioned also *Thelazia rhodesi*, found in 1818 by Rhodes (a veterinary of Plaisance), in the excretory ducts of the lachrymal glands and beneath the eyelids of cattle. This worm, to my mind, would explain very well a peculiar localization of cancer in bovines—the epithelioma of the lachrymal caruncle. Of a total of 2,514,000 bovines slaughtered at the Chicago abattoirs, Loeb and Jobson, limiting their

investigations to external cancers, found forty-nine cases, but it is worthy of notice in this connection that all these cancers were epitheliomas of the lachrymal caruncle!

Passing to Acarines, I recalled Borrel's numerous researches on cancer of the hair follicles and of the sebaceous and mammary glands, brought about by the parasitism of *Demodex folliculorum* and other ectodermic acarines. In nascent epitheliomas removed by biotomy Borrel always found *Demodex* in the follicles undergoing cancerous degeneration. He demonstrated them likewise in great numbers in the nipple in several carcinomata of the female breast.



Case of elephantiasis in Hindu girl. Drawing by Mr. A. Terz from a photograph taken by Dr. Sambon in George Town (British Guiana).

Having found *Demodex* very numerous in large comedones on the scrotum and penis of a syphilitic chimney sweep, I wondered whether Borrel's observations might not give us the reason of the frequency of scrotal cancer in chimney-sweeps, seeing that, owing to constant dusting of their genital region with soot comedones are prone to form, while these accumulations of sebaceous matter are favourable breeding grounds for the small vermiform acarine.

Finally, in order fully to explain the part played by helminthes in the production of cancer, I gave a sketch of our present knowledge of the causes which bring about elephantiasis. This disease, which is very common in certain tropical regions, was, not long ago, believed to be hereditary, contagious, due to malaria or produced by certain foods such as pork, stockfish, wild duck or the bright orange-coloured fruit of the fragrant kaldera (*Pandanus odoratissimus*).

I pointed out that, with us, as in tropical countries, elephantiasis is always the result of repeated attacks of streptococcic lymphangitis in an œdematous region with lymphatic and vein dilatation caused by obstruction of diverse origin (local tuberculosis, tertiary syphilis, helminthiasis). In northern countries, elephantiasis is a somewhat rare disease, but in certain warm countries it prevails endemically with varying frequency. This tropical form has received the name of filarial elephantiasis, because a filaria (*Filaria bancrofti*) discovered by Demarquay in 1863, plays a part of the greatest import in its ætiology. The close relation of cause to effect which exists in tropical countries between elephantiasis and filariasis is proved very clearly by:

(1) The geographical and topographical distribution of elephantiasis exactly coincident with that of filarial endemicity.

(2) The frequency of the disease everywhere proportionate to that of filarial infestation.

(3) The concurrent presence of other filarial manifestations such as varicose groin-glands, lymph scrotum, chylocele, chyluria and filarial abscess in patients suffering from elephantiasis.

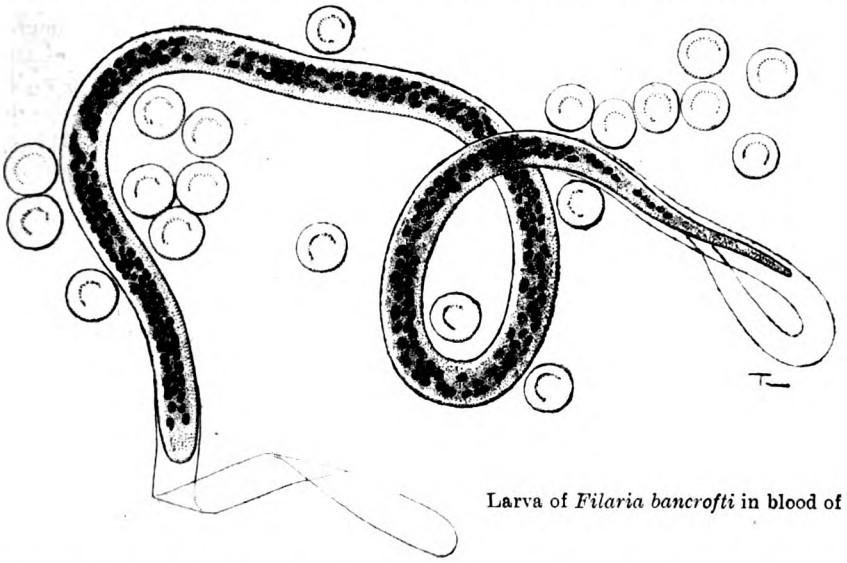
(4) The frequent onset of elephantiasis of the leg following the surgical removal of lymph scrotum.

I recalled the part played by mosquitoes (several species of *Culex*, *Aëdes*, *Anopheles* and *Tæniorhynchus*) in the transmission of filariasis, rôle demonstrated by Manson in 1877, but the final details of which were not worked out until 1900. I showed how the young filariæ, leaving the massive wing-propelling thoracic muscles, actively migrate to the mouth parts of their intermediary insect host, pierce the delicate membranes at the base of the hypopharynx (Sambon), or between the two stretched out labellæ at the extremity of the labium (Dutton), whilst blood is being imbibed, and drop on to the punctured part; how they creep over the skin, picking up surface bacteria and make their way through the epidermis, finally reaching the connective tissue and the lymphatic vessels of their definitive host. I mentioned how, not infrequently, numbers of them, coiled up in inextricable tangles, might obstruct lymphatic vessels and, acting as porters of bacterial infection, introduce into the lymph stream micro-organisms which finally kill them—hence the reason why microfilariæ seldom are found in the blood of elephantoid cases.

There can be no doubt that streptococcic lymphangitis is the real, essential cause of elephantiasis, whether nostras or tropical, but in warm countries, a filaria is the agent which almost invariably gives rise to it. Indeed, it is *Filaria bancrofti* which determines the variable frequency and unequal distribution of the disease, limited, in each country, to those localities or

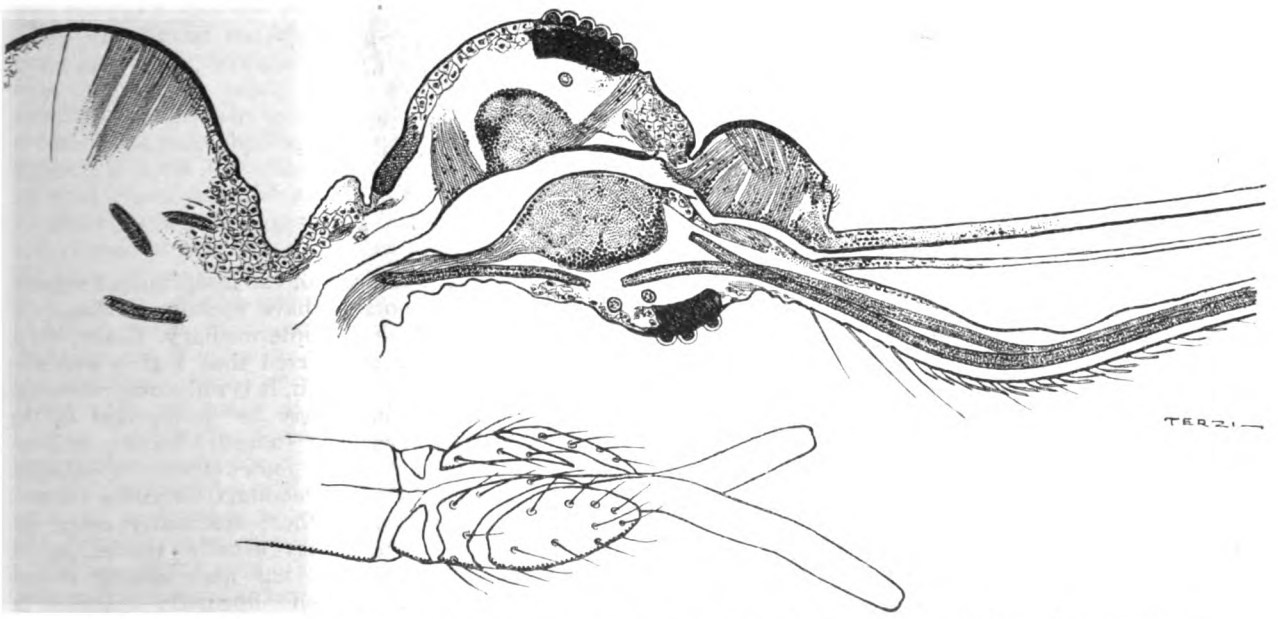
"stations" that are the separate, overlapping, or coincident habitats of the several mosquitoes which may foster it and transmit it. Prominent among these are: *Culex fatigans* in China, *Aëdes togoi* in Japan, *A. variegatus* and *C. fatigans* in Fiji, *Anopheles rossi* in India, *A. costalis* in West Africa and *Tæniorhynchus africanus* throughout Tropical Africa.

Similar to the rôle of the filaria in elephantiasis is, no doubt, that of gongylonema in cancer. Like the filaria, so the gongylonema is not the direct essential cause of the disease it gives rise to, but it probably is, in certain localities, an etiological factor of considerable importance. Like the filaria, so the gongylonema has its own particular intermediary hosts belonging to different insect genera such as *Blatta*, *Blaps*, *Tenebrio*, *Aphodius*, and *Onthophagus*. The gongylonema, known to be a cancer-producing agent in the rat, seems an equally likely factor in the incidence of cancer among human beings in certain regions such as the Romagna and the Trentino. Here the disease affects principally the upper portion of the alimentary tract and more especially the buccal cavity, the tongue, the œsophagus, the larynx and the cardia, and here again cockroaches, meal-beetles and cellar-beetles are an ever present vermin in the old houses in which such cancer cases occur. These observations so clearly designative of a relationship between worm and neoplasm, are strengthened by the fact that gongylonema is present and common in the majority of the domestic animals of these regions. Professor Fibiger's researches and experiments have proved that gongylonema plays a definite part in the production of gastric carcinoma in rats. Why should it be otherwise in man?



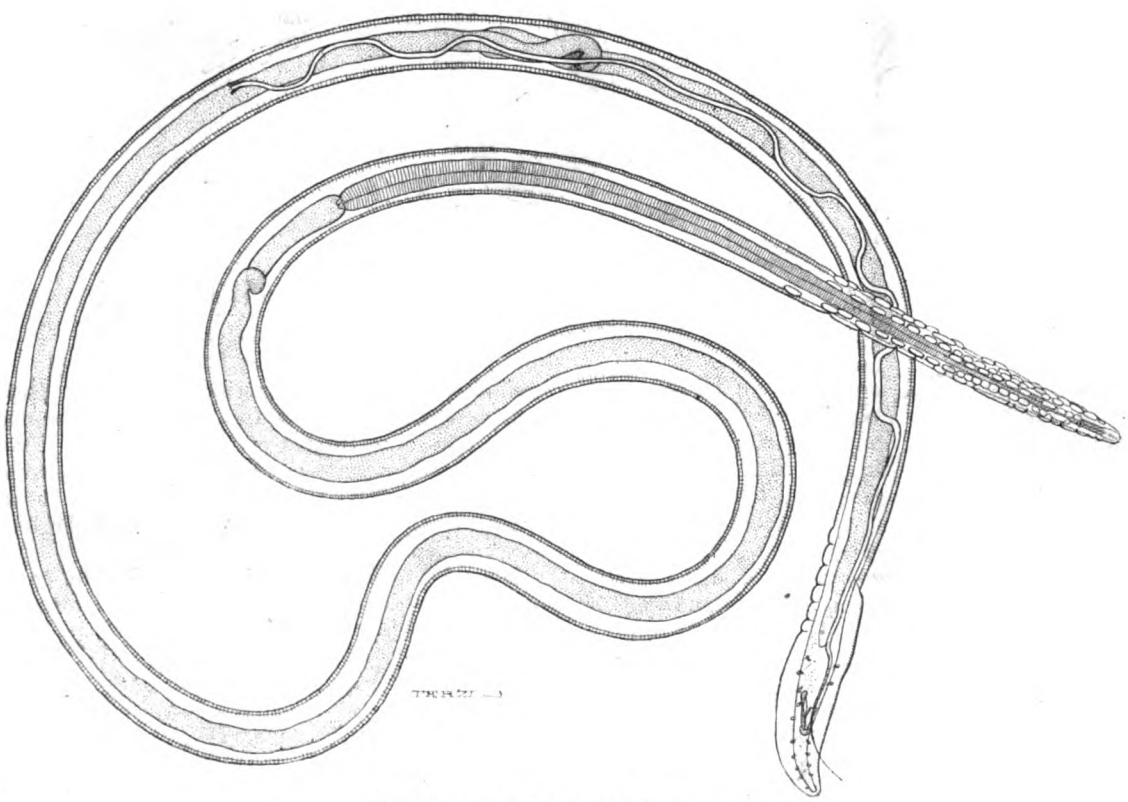
Larva of *Filaria bancrofti* in blood of man.

During the few weeks I could devote to cancer research in Italy, I was unable to demonstrate the



Filaria bancrofti. Two specimens actively migrating through labium of *Culex fatigans*. (From ction prepared by Dr. G. C. Low.)

presence of *Gongylonema* in man, because I had only two opportunities of seeing autopsies performed and that was at Bologna, by courtesy of Professor Franchini. But the presence of *Gongylonema* in man is certain. This Spiruroid has been found, not only recently, on several occasions, in the United States of America (Arkansas, Florida, Georgia, Louisiana) but also in Italy by Professor Pane in 1864. Though fully aware that some parasitologists may consider my interpretation of Pane'e *Filaria labialis* as unsatisfactory, I not only hold that it is correct, but am convinced that the *Gongylonema*, though no doubt accidental, is no rare parasite of man in Italy. That it should have escaped medical observation is but a twice told tale; we see only that for which we look. surgeon of the Trentino, Dr. Piero Cavallo, a capable, learned and charming person who was keenly interested in our researches, told me that *Gongylonema* had been found at Rome in oxen imported from Sardinia. *Gongylonema* is a parasite of cattle as cosmopolitan in distribution as are its hosts and everywhere more or less abundant. Parasitologists have noted its presence in the five continents. Its favourite habitat is the œsophagus, but it may be found in the lip, the buccal cavity, the tongue, the larynx, the liver, the cardiac portion of the stomach in carnivores and omnivores and in the rumen of ruminants. Lingard saw it in the œsophagus and in the tunica intima of the posterior aorta in the Brahmin Bull of the plains of India. It is found as a rule, in sinuous galleries



Gongylonema pulchrum (Molin, 1857). ♂

One could cite the examples of *Hymenolepis nana*, *Fasciolopsis buski*, *Agchylostoma duodenale*, *Linguatula serrata*, *Nocardia bovis* and many others. No one saw the *Treponema pallidum* before Schaudinn pointed it out; no one saw *Trypanosoma gambiense* in sleeping sickness until Castellani found it, yea, not even the members of the Portuguese Commission who had it in their slides, as they discovered afterwards. Stranger still is the fact that *Gongylonema*, so common in Italian sheep, oxen and hogs, should have escaped detection by the abattoir veterinarians. They had not seen it, they had not looked for it; the œsophagus is inspected so seldom. But the chief veterinary within the epithelial layer of the œsophageal mucosa.

For obvious reasons, I have spoken at length of *Gongylonema* and of its intermediary hosts, but I should not like it to be inferred that I give exclusive importance to it for, in truth, it is only one of several animal parasites which may be concerned in the complex etiology of cancer. Indeed, I have mentioned others, such as *Demodex folliculorum*, *Trichinella spiralis*, *Schistosoma hæmatobium*, *Clonorchis sinensis*, *Opisthorchis felineus*, but there are many more, not only among the helminthes usually recognized as natural parasites of man, but also among chance parasites' parasites which normally develop in

animals, though at times they may accidently spend their life in man. Thus *Metastrongylus apri*, a parasite of the hog, was found in 1845 by Jortsits in the lungs of a child of six, at Kolozsvar (Transylvania). This parasite is capable of giving rise to neoplasms; Vulpain found it associated with epithelial tumours in the lung of a pig seven months old, sacrificed for physiological studies. The large common fluke of sheep and cattle, *Fasciola hepatica*, also is found occasionally in man. Like *Opisthorchis felineus*, it may give rise to biliary adenomas. Less known is the *Physaloptera*, discovered by Turner in the small intestine of Transvaal negroes and described by Leiper, in 1908, under the name of *Physaloptera mordens*. An Oriental species, called *P. tumefaciens*, produces, as shown by Professor Brumpt, large adenomatous formations in the stomach of its normal host, the crab-eating macaque (*Macacus cynomolgus*), which has the habit, peculiar in a monkey, of feeding largely on crabs, insects and mollusks. Quite recently, a liver parasite of the rat, *Hepaticola hepatica*, has been found by Dive, Lafrenais and MacArthur in the liver of a British soldier aged twenty, in India. The liver was crammed with the characteristic lemon-shaped eggs bearing a plug at each pole. Dr. Baylis will tell you how we found this parasite in every rat we caught at the Bologna abattoir.

One might go on almost indefinitely, but I must restrict my remarks to the so-called erratic worms, that is to say those worms that are found in parts of the body other than that in which they habitually abide. Thus the common liver fluke *Fasciola hepatica* may be found in the pancreas, in the lung, or in cutaneous nodules. *Oxyuris vermicularis*, a parasite of the cæcum and colon, may be found in the nasal fossæ, buccal cavity, the œsophagus, the urinary bladder, the vulva, the vagina, the uterus and even the ovaries, or the abdominal cavity, free, deeply embedded or encysted. *Ascaris lumbricoides*, a parasite of the small intestine, may be found in the œsophagus, the liver, the pancreas, the peritoneal cavity.

But we should not confound erratic worms with young forms migrating through the body during their invasion. In a paper on "The part played by metazoan parasites in tropical pathology," an abstract of which was published in the JOURNAL OF TROPICAL MEDICINE AND HYGIENE, June 15, 1908, I pointed out that our intestinal parasites did not slide down the gullet, as was believed then, but, piercing the skin or the mucous membrane, reached their final habitats, travelling by way of the blood-vessels and lymphatics or through cellular-tissue routes. I gave several examples, such as those of *Ascaris lumbricoides*, *Agchylostoma duodenale*, *Syngamus trachealis*, *Heterakis papillosa*, based on observations and researches I was able to make at the prosectorium of the London Zoological Society. My views have been confirmed in each case.

I am inclined to give some importance to erratic parasites, and more especially to *Trichinella spiralis* and *Oxyuris vermicularis*. These worms may play one of two parts in the ætiology of cancer, either as porters of bacterial infection, like *Filaria bancrofti* in the case of elephantiasis, or else as irritants like any foreign body. In either case their importance is obvious, because if they do play any part in the causation of cancer, and the facts adduced strongly suggest it, then we have in this knowledge a sure means for the eradication of cancer, in so far, at least, as it is brought about by the agency of parasitic worms. The majority of these worms have necessary intermediary hosts (insects, snails, fish) which it may be possible to control, or they ambush in food which may be rendered harmless by proper cooking.

As our knowledge begins to close round the causation of cancer, many old theories, many wrongly interpreted observations become comprehensible. Thus, the eating of pork long has been incriminated as a cause of cancer; the flesh of the hog itself may be harmless, but in it often lurk some of the more fatal zoöparasites of man; hence the exceedingly wise Mosaic prohibition of its use as human food. Among these parasites, *Trichinella spiralis* is, without doubt, the most fearful, not only for the deadly epidemics of trichinosis to which it may give rise, but for the part it may play in the causation of cancer and more especially cancer of the breast. Mammary cancer often has been observed in association with trichinosis; I need but mention the observations of Klopsch, Langenbeck, Babes.

Uncooked vegetables, repeatedly incriminated, may well be responsible in like manner. Behla's observations at Luckau, in Germany, are well known. Sir John Bland-Sutton in his lectures on "Cancer clinically considered" (London, 1909), talking of uncooked vegetables in relation to the origin of cancer, says: "Indeed I feel so strongly on this matter that for many years I have avoided eating all sorts of uncooked vegetables." It is common knowledge that the eggs of pinworms and eelworms may reach us through eating uncooked vegetables.

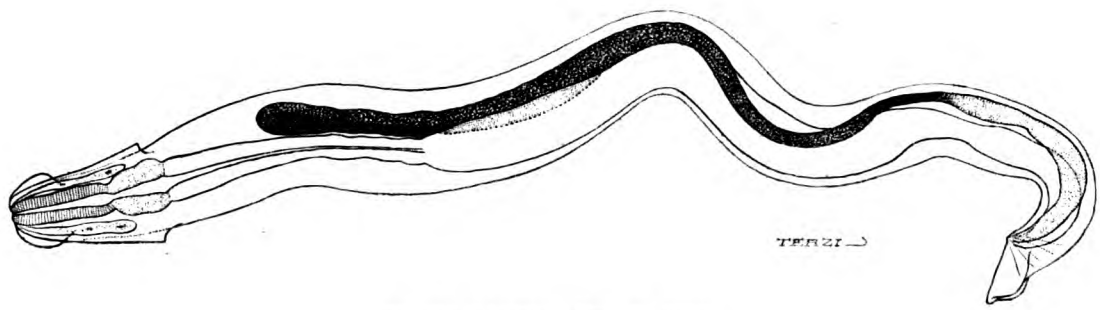
Whatever be the rôle of parasitic worms, the actual essential cause of cancer is some ubiquitous micro-organism, probably a filter-passer, as the researches of Rous and his fellow workers seem to indicate, but this parasite, apparently, is unable to thrive except in tissues of low or lowered resistance. We see it therefore affect embryonic residues, pigmentary moles, burn scars, goitrous thyroids, breast adenomas, the margin of gastric ulcers, the lesions of dysentery, syphilis and tuberculosis, as well as those caused by the irritation of foreign bodies or by the parasitism of helminths.

Finally, apart from the parasitological observations and considerations submitted, I venture to believe that this rapid survey of cancer conditions in certain districts of Iceland and Italy proves the usefulness of intensive scientific research in limited areas of different countries where the disease is most prevalent and indicates the uselessness, even the misguiding effect, of statistics, such as are compiled in central official bureaux by mixing and blending data of very different import and value, gathered from innumerable localities and losing, in the confusion resultant, precious facts—dissolving, as it were, pearls in vinegar. But, inscrutable as the ancient Oracles, the Health Boards of our day will continue to scribble figures

as if it were possible to stay the phalanges of Death by the exorcism of numbers, or by some mystic word such as:

A B R A C A D A B R A
A B R A C A D A B R
A B R A C A D A B
A B R A C A D A
A B R A C A D
A B R A C A
A B R A C
A B R A
A B R
A B
A
I

The local mice had yielded a considerable percentage of cancerous growths, those from Mayence not one. Borrel looked for the condition which might explain this difference, and found that the local mice were infested with a "filaria-like" worm, which was absent from the Mayence mice. He gave me slides with shreds of mouse skin containing the worms, and I found that there were two kinds of nematode worms. One is an *Oxyuris*, the *O. tetraptera*, first described by Nitzsch, in 1821, under the name of *Ascaris tetraptera*. [This oxyurid is found in the large intestine of the house-mouse (*Mus musculus*), the long-tailed field-mouse (*Apodemus sylvaticus*), the common hamster (*Cricetus frumentarius*) and the jerboa (*Jaculus jaculus* and *J. sagitta*)]. The other is a new species, and, I believe, a new genus, though, prob-



Oxyuris tetraptera (Nitzch, 1821).

After the Paris Lecture.

The day after my address at the Institut Pasteur, Professor Borrel invited me to go with him to Strasburg, where he could show me all his preparations, the work of many years on cancer. Professor Calmette also urging me to go, I accepted, and we left by the night train to spend the next day in Strasburg. Most interesting, instructive and delightful was the day spent in Borrel's laboratory in the superb bacteriological institute built by the Germans not long before the war. I examined numerous sections of all kinds of tumours in which the connection between parasite and neoplasm was unmistakable. Some were sections of skin epitheliomas with *Demodex folliculorum* embedded in the growth, others sarcomas of the liver or kidneys of rats with the nascent neoplasm, no larger than a pin's head, budding out, as it were, from the capsule of *Cysticercus fasciolaris*, others again, sections of horse testicle with either *Setaria equina* or *Strongylus equinus* as the exciting cause of the growth.

Borrel showed me the centuries of white and piebald mice he was using for his tarring experiments. The actual tarring was the work of an Alsatian maiden, in whose hand a rose would have seemed more appropriate than a mouse, with an ugly sore on its sooty, depilated back. One of the tarred mice had developed a huge horny excrescence which seemed likely to outgrow that of the famous widow Dimanche. There were two sets of mice, one of Strasburg mice, the other of mice from Mayence. ably, seen by Redi (1684), long ago in the inguinal glands of the common mouse.

The material at my disposal consists of seven females (several broken) all in poor condition and embedded in the balsam-smeared reticular layer of the skin. Yet I venture to submit a short preliminary description and some drawings of this interesting nematode:

Genus *Muspicea* gen. n.
Species *Muspicea borreli*, sp. n. (Type sp.)
Host—the Common Mouse (*Mus musculus*)
Location—Sub-cutaneous connective, inguinal glands.
Locality—Strasbourg.

Specific diagnosis.—Body short and stout, somewhat spindle-shaped, but thicker at the anterior end, attenuated posteriorly and terminating (in the female at least) in a bilobed tail; lobes strikingly mammilloid. Cuticle transversely striated, striations prominent, interval between them about 10 microns. Mouth simple, œsophagus followed, apparently, by slight subspherical bulb. Intestine straight, thin-walled, of almost uniform diameter. Anus opens between tail lobes. Large nucleated cells, probably representing glandular structures, about œsophagus. Viviparous.

Female 2·87-3·40 mm. long, 110-160 microns thick at broadest anterior portion, 50-75 microns at narrowest portion near tail. Tail lobes about 20 microns long. Uterus apparently a continuous tube, in all probability consisting of two opposed branches. In one immature form there appear to be two ovaries situated at opposite ends of uterus, in later stages the

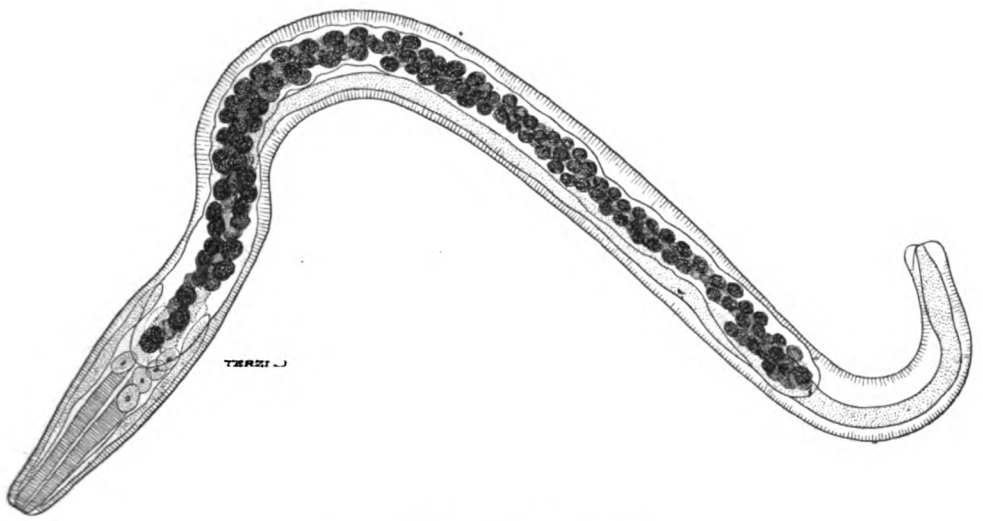
ovaries cannot be made out and the large sack-like uterus is filled with either undeveloped subspherical eggs, or fully developed embryos. The vagina probably opens about the middle of the body, but it cannot be made out clearly in specimens at hand.

Larva—270 microns long, 18 microns thick at broadest posterior end of body. Tail bilobed, lobes nipple-like. Anterior to tail-end a large papilla-like projection on each side of the body. Œsophagus with slight œsophageal bulb. Intestine straight. Mouth with, apparently, six papillæ.

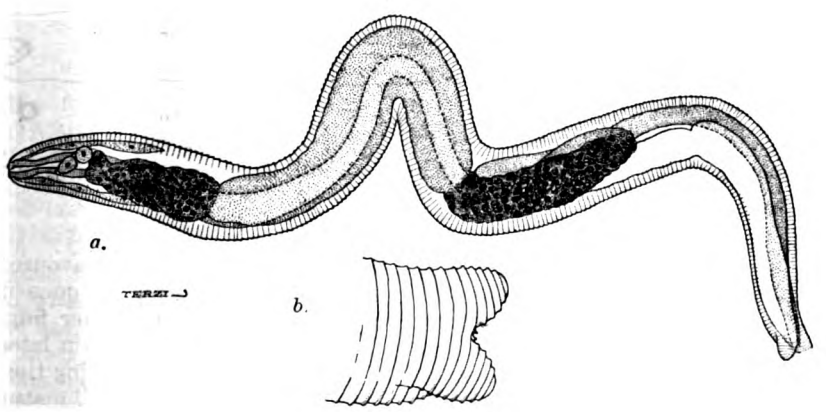
In the new Pasteur Museum, annexe of the Bacteriological Institute, I further had the opportunity of examining several specimens of crown-gall in plants inoculated with the *Bacterium tumefaciens* of Erwin Smith. What a striking thing is this plant-neoplasm, so like animal cancer in its appearance, mode of growth, permeation, metastases and deadliness!

ALESSANDRINI'S GONGLYONEMA.

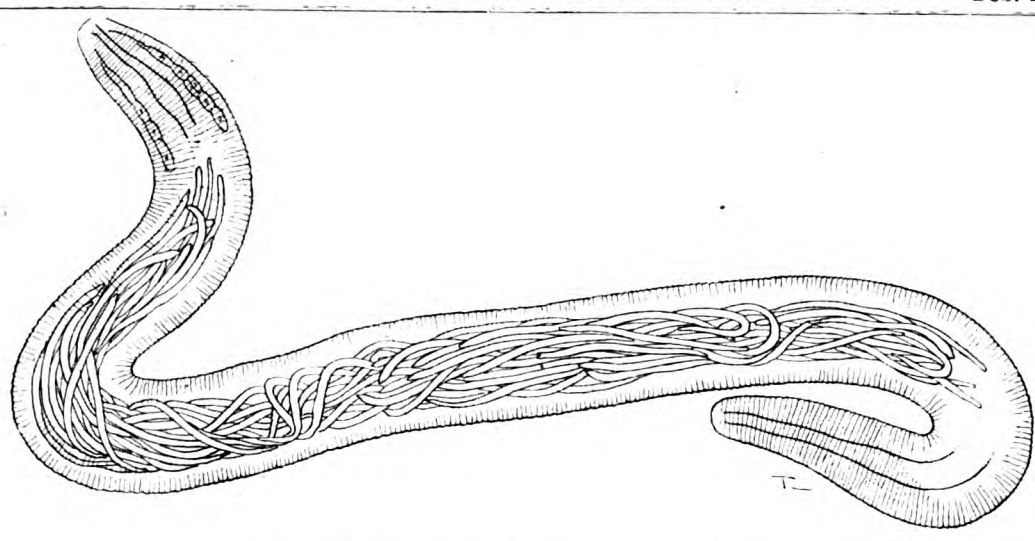
A few days ago, the well-known natural history artist, Mr. A. Terzi, who had been drawing for me the exquisite pictures of insects illustrating this paper, brought me a reprint of an article by Professor Giulio Alessandrini, of Rome, on a case of Gongylonema infection in man. This paper, published in 1914, had not only escaped my notice, but also that of other parasitologists, such as Baylis, in this country,



Muspicea borreli Sambon, 1925.
Young female.



Muspicea borreli Sambon, 1925
a, immature form. *b*. posterior extremity.

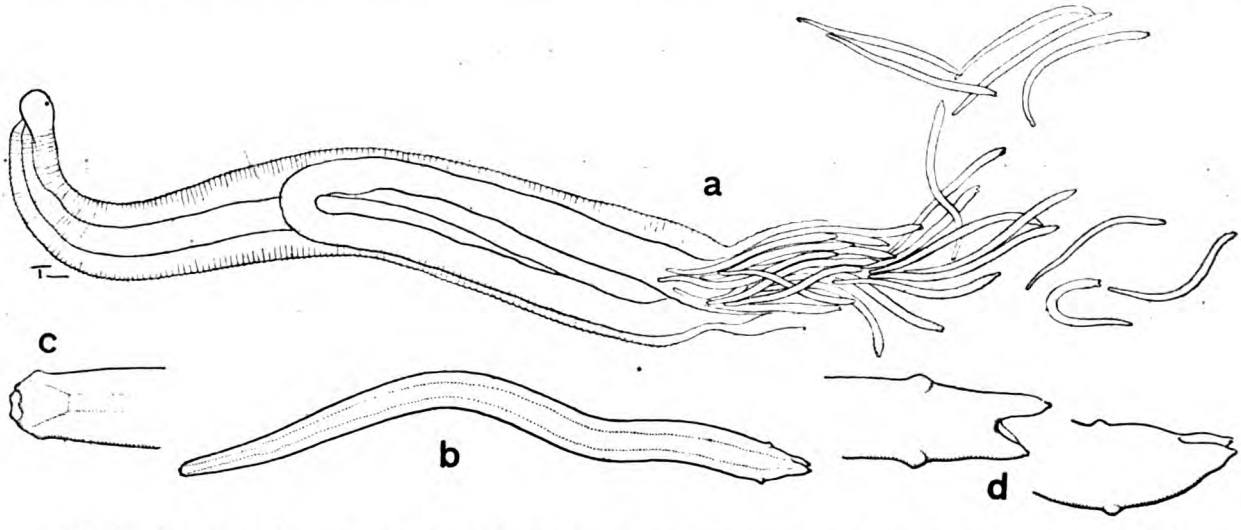


Muspicea borreli Sambon 1925. Fully mature female.

Hassall, Ransom, Stiles, Ward, in the United States of America. Indeed it is not even mentioned in the American index-catalogue of medical and veterinary zoology.

In one way, I regret this oversight; it seems almost unpardonable, especially as Professor Alessandrini's paper was published in the *Bulletin* of the Royal Medical Academy of Rome (year xxxx, part IV). On the other hand, had I known of Alessandrini's paper, I should not have discovered Pane's earlier finding, nor might I have returned to Italy last summer, where so much interesting material was collected.

Professor Alessandrini describes the finding of no less than six worms of the genus Gongylonema in a young woman 18 years of age from Saracinesco, a hill village on the river Aniene, between Tivoli and Mandela (Rome). The worms occupied sinuous galleries which they had made beneath the epithelium of the buccal cavity, some at the root of the tongue, others near the frenulum. Whenever the parasites protruded from their galleries, the patient felt the unpleasant sensation of having something like a hair in her mouth and endeavoured to draw out the worm, but the latter at once made resistance, and usually, slipping out of her fingers, withdrew within its gallery to protrude again later.

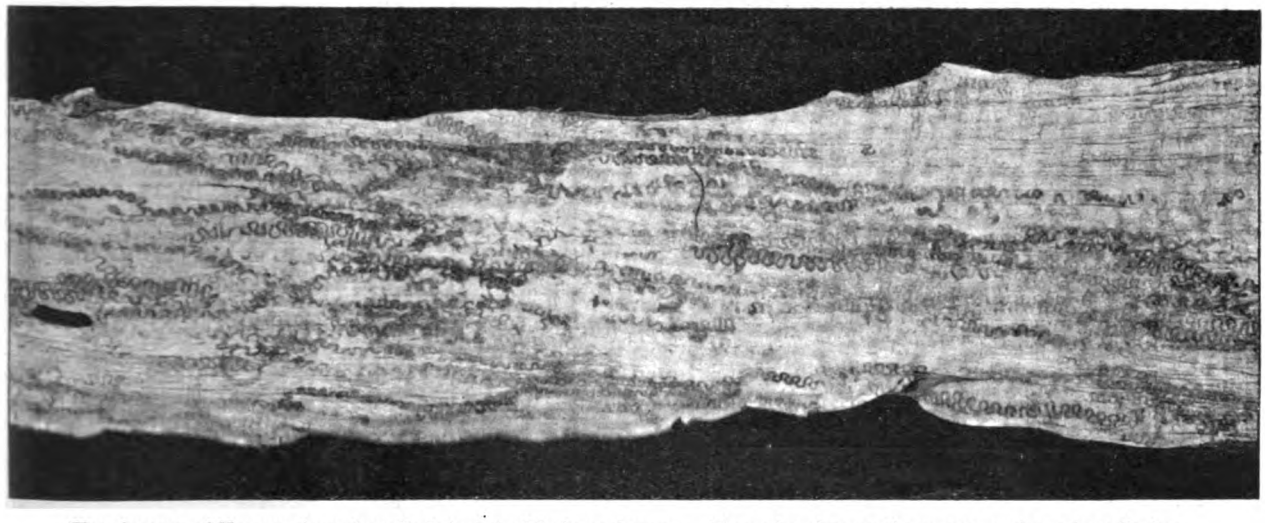


Muspicea borreli, Sambon 1925, *a*, broken body of mature female with larvæ escaping: *b*, *larva*: *c*, anterior extremity of larva; *d*, posterior extremity of larva.

Of the six worms infesting the patient Alessandrini was able to secure three, all mature females, the others had been thrown away. Unfortunately, Professor Alessandrini gives neither measurements nor exact description of the interesting worms he had the opportunity of examining. He says: "The species

found by me as a parasite of man although approximating to that of the hog (*Gongylonema pulchrum*) cannot be considered the same. It differs from it especially on account of its greater length, its greater slenderness and because the scutes on the anterior portion of the body occupy a space twice as long; the eggs also are smaller and relatively more elongate. I propose therefore to consider it a new specie and call it *Gongylonema subtile*."

In a previous paper, Alessandrini mentioned the finding of *Gongylonema* in sheep of the Roman Campagna and in cattle imported from Sardinia, findings of which I had been informed by Dr. Piero Cavallo in Trento. No doubt Alessandrini has preserved the Gongylonema worms he found in man and, seeing the importance they have acquired, will furnish a more detailed description accompanied by exact measurements. Dr. Baylis's paper should be very helpful. He, having examined a large amount of material, is inclined to look upon the names of certain species described from various hosts as synonymous.



Œsophagus of Faenza sheep heavily infested with *Gongylonema*. The paler sinuous lines represent empty galleries. (Photograph by Dr. L. W. Sambon.)

ON *GONGYLONEMA* COLLECTED IN ITALY DURING OCTOBER, 1924, WITH SOME OBSERVATIONS ON THE GENUS.

By H. A. Baylis, M.A., D.Sc.

Department of Zoology, British Museum (Natural History).

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The material collected in Northern Italy during the writer's expedition with Dr. L. W. Sambon in the autumn of last year has not all been completely worked out, but the most important point was to determine what were the species of *Gongylonema* met with in the region. Owing to lack of time and facilities for the detailed study of material during the expedition, this had to be left until our return to England. We were under the impression that we had obtained four species of *Gongylonema* from the various animals examined, but, as will be explained, this number has now been reduced to one.

In the first place, we found in the walls of the stomach of a wild rat, captured in the public slaughter-house at Bologna, some slender worms which seemed likely to be *G. neoplasticum* Fibiger and Ditlevsen. Microscopic examination, however, at once showed that they were not *Gongylonema* at all. They appear to be examples of *Hepaticola hepatica* (Bancroft) in an unusual situation. In the liver of the same rat (and indeed of almost all the rats examined) there were masses of the eggs of this worm, and these agree very closely with those of the worms found in the stomach.

Again, in a number of fowls the walls of the crop were found to be invaded by very slender worms which, from the naked-eye appearances, were thought to be in all probability *G. ingluvicola* Ransom. They prove, however, to be a species of *Capillaria* which has not as yet been determined. In these two cases, therefore, we have Nematodes whose habitat and mode of life are similar to those of *Gongylonema*, and which, without the aid of the microscope, may readily be mistaken for it. It seems possible that, if pathological effects may result from the presence of *Gongylonema*, similar effects might be produced by *Hepaticola* and *Capillaria*. In this connection it is of some interest to recall that a case of *Hepaticola* in the human liver has recently been recorded by Dive, Lafrenais and MacArthur.[1] Another worm of somewhat similar habits and naked-eye appearance is *Onchocerca armillata*, which furrows in the internal coat of the aorta of cattle, and causes the formation of nodules or tumours.

G. scutatum was found in great abundance in sheep, goats and cattle in the region investigated. At

[1] *Journ. Roy. Army Med. Corps*, xliii, pp. 1-4 (1924).

TABLE I.—MEASUREMENTS OF *GONGYLONEMA SCUTATUM* (ORIGINAL)

The figures given in this table refer to the largest male and female in each set of specimens.
The measurements in all the tables are in millimetres.

ORIGIN OF MATERIAL.	GOAT Italy.		GOAT India.		GOAT Algeria.		SHEEP Italy.		SHEEP Algeria.		OX Italy.		OX United States of America.		ZEBU (*Bos indicus*) India.	BUFFALO India	BUFFALO India.
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♂	♀
Length	62	135	43	113	39	80	52	130	30	85	47	80	55	95	30	35	74
Maximum thickness	0·36	0·53	0·25	0·45	0·3	0·4	0·3	0·47	0·26	0·35	0·27	0·35	0·29	0·4	0·2	0·2	0·34
Anterior end to end of œsophagus ..	7·0	·0	5·5	8·0	5·5	6·8	7·0	7·5	—	8·5	6·5	8·0	6·5	9·0	6·0	6·3	7·75
,, ,, ,, end of muscular portion of do.	0·78	0·95	0·6	0·83	0·5	—	0·7	0·85	—	0·8	0·75	0·7	0·74	0·95	0·55	—	0·75
,, ,, ,, cervical papillæ ...	0·17,0·19	0·18,0·2	0·15	0·22	0·122	—	0·18	0·2	0·125	0·14,0·15	0·14,0·15	0·16,0·17	0·16	0·2	0·15	0·137	0·15
,, ,, ,, commencement of alæ	0·24,0·26	0·27	0·19	0·3	0·163	0·2	0·2	0·25	0·16	0·23	0·21	0·24	0·25	0·29	0·2	0·175	0·22
,, ,, ,, nerve-ring ...	0·35	0·39	0·3	0·38	—	0·25	0·35	0·4	—	—	0·3	0 35	0 325	0·375	0·3	—	0·35
,, ,, ,, excretory pore ...	0·6	0·9	0·47	0·8	0·47	0·53	0·65	0·83	—	0·69	0·58	0·75	0·6	0·75	—	0·45	0·65
Length of tail	0·3	0·38	0·3	0·26	0·34	0·34	0·3	0·33	0·24	0·3	0·35	0·32	0 35	0·38	0·3	0·27	0·2
Diameter of buccal rim	0·0275	—	0·0225	—	0·03	0·03	0·03	0·03	0·03	0·03	—	0·03	0·03	0·03	0·0275	0·0275	0·03
Length of pharynx	0·0675	0·075	0·05	0·0625	—	0·05	0·06	0·07	0·052	0·065	0·0625	0·0525	0·0625	0·065	0·045	0·05	0·05
Cuticular striations, interval between	0·0175	0·0175	0·01	0·0175	0·015	0·02	—	0·017	0·0125	0·0175	0·013	—	0·0075 to 0·015	0·017	0·015	0·015	0·0175
Length of spicules ... Left ...	19·0		7·5		8·0		20·0		8·0		18·0		23.0		14·0	5·0	—
Length of spicules ... Right ...	0·16		0·14		0·14		0·15		0·13		0·15		0·15		0·14	0·13	—
Length of accessory piece	0·12		0·1		0·1		0·11		0·1		0·12		0·12		0·12	0·1	—
Vulva from posterior end	5·0		5·5		7·0		5·5		5·0		4·0		5·0		—	—	4·0
Ova, length	0·062	0·065	0·055		0·06		0·065		0·05*		0·065 —	0·067	0·065		—	—	0·058
,, breadth	0·035 —	0·037	0·032		0·035		0·037		0·025*		0·35 —	0·037	0·035		—	—	0·034

* In this case the eggs measured were in the uterus, there being none in the vagina. In all other cases they were in the vagina.

TABLE II.—MEASUREMENTS OF *GONGYLONEMA PULCHRUM* AND *G. RANSOMI.*

	G. PULCHRUM.						*G. RANSOMI.*	
Origin of Material.	PIG. Algeria.	PIG. Italy.	WILD BOAR. Algeria.	WILD BOAR. Algeria.	DONKEY. Algeria.		PIG. United States of America.	
Author and date.	Seurat, 1916.	Baylis, 1925.	Neumann, 1894.	Baylis, 1925.	Seurat, 1916.		Chapin, 1922.	
	♂	♀	♀	♂	♀	♂	♀	♂	♀	♂	♀
Length	19·5	54·3	40	14·5—19·25	37—40	12	37	27·8	40·5	23	37
Maximum thickness	0·17	0·24	0·25	0·175—0·195	0·35	0·14	0·19	0·215	0·25	0·149	0·19
Anterior end to end of œsophagus	4·82	7·3	6·0	—		3·0	6·5	5·8	6·5	2·85	4·5
,, end of muscular portion of œsophagus	0·54	0·7	0·48	—		0·4	0·65	0·54	0·7	0.4	0·5
,, cervical papillæ	0·11, 0·115	0·147, 0·165	0·15	—		0·075	0·13	0·105	—	0·122	0·145, 0·154
,, commencement of alæ	0·16—0·165	0·22—0·24	0·2	—		0·1	0·19	0·16	0·2	—	
,, nerve-ring	—		0·29	—		—	0·275	—		—	
,, excretory pore	0·41	0·575	0·54	—		0·3	0·46	0·39	0·48	—	
Length of tail	0·245	0·185	0·2	—		0·22	0·19	0·25	0·25	0·25	0·2
Diameter of buccal rim	—		0·03	—		0·0275	0·025	—		—	
Length of pharynx	0·052	0·05	0·0625	—		0·05	0·05	0·045	0·05	—	
Cuticular striations, interval between	0·013		0·0125	—		0·005	0·0125	—		—	
Length of spicules Left	4·3		—	4—5		4·0		5·8		10·03	
Length of spicules Right	0·105		—	0·084—0·11		0·13		0·105		0·106—0·13	
Length of accessory piece	0·07		—	—		—		0·075		0·084	
Vulva from posterior end	3·135		1·95	2·0		2·7		2·6		1·75	
Ova, length	0·052		0·062-0·07	0·052—0·056		0·0625		0·052		0·053—0·058	
,, breadth	0·03		0·0325—0·035	0·032		0·035		0·03		0·031—0·033	

Faenza, for example, where we examined a large number of sheep, we saw only one which was free from infection with this worm. On comparing the existing descriptions of *G. scutatum*, the curious fact came to light that, while authors dealing with European material described the long left spicule of the male as 16 to 17 mm. long, Seurat, studying Algerian specimens, gave it as only 8·5 to 9·5 mm. The writer had the good fortune, through the kindness of Professor Henry, of the École Nationale Vétérinaire at Alfort, to be able to examine specimens from a sheep and a goat from Algeria, and to compare them with the Italian specimens. Curiously enough, it was found that in these Algerian specimens also the length of the left spicule averaged about 8 mm., and they thus agreed closely with those described by Seurat. It seemed possible that the Algerian forms might represent a local race or even a species distinct from the European *G. scutatum*. However, no other important difference could be found between different sets of material from various parts of the world (Table I). The length of the left spicule was found to vary between 5 mm. in a specimen from an Indian buffalo[1] and 23 mm. in a specimen from a North American ox.

Whether these differences have any fixed local distribution, or whether the length of the left spicule is equally variable in all localities, is a point that can only be settled by the examination of long series of specimens. For the present it seems preferable to adopt the latter supposition. Moreover, it must be admitted that we do not yet know to what extent the spicules of Nematodes continue to grow in length during the life of the individual. It is commonly assumed that, once they have become chitinized, the spicules cease to grow. This, however, is no more than an assumption, and a good deal of evidence might be adduced which points in the other direction. The proximal, or "root," end of the spicules very frequently has an unfinished appearance, as if the process of chitinization were not yet complete. It seems not at all improbable that the process is a gradual one, going on indefinitely as long as the spicule continues to increase in length, and this, for all that is known, may be for a considerable time after the worm has completed its last moult.

We may now pass on to consider the specimens obtained from pigs in Italy. Unfortunately, we obtained only two female examples of *Gongylonema*, which were found in two different pigs. The reason for the scarcity of material, as we only discovered when it was too late, was, no doubt, that all the pigs which we examined had been fed on waste products from a cheese factory, and not allowed to forage for themselves, so that they had had few opportunities of ingesting the intermediate hosts of *Gongylonema*. These two specimens, however, were compared with others from a wild boar from Algeria, determined by Professor Railliet as *G. pulchrum* Molin. Careful series of measurements were made (Table II), as the result of which it seems almost certain that the species found in swine, both domestic and wild, in Europe and North Africa, is identical with the *G. scutatum* of ruminants. The only constant difference is the smaller average size of the worms from the pig and wild boar. Mere total dimensions, as is now generally recognized, are of little importance among Nematodes. We know that in many cases (as for instance, has been shown by Ransom for *Syngamus trachealis*) Nematodes tend to grow larger in those hosts to which they are better adapted. It is not unlikely therefore, that the ruminants are the animals in which *G. scutatum* has been longest established, and in which it finds its requirements best fulfilled, and that the small size of the *Gongylonema* of swine is merely the result of imperfect interadaptation between the parasite and its host. Specimens of *Gongylonema*, attributed to *G. pulchrum*, are occasionally found in horses and donkeys, and these are likewise undersized, probably for the same reason.

The view has recently been taken by American helminthologists that the *Gongylonema* of the pig in the United States differs from that of European pigs. It was described by Chapin in 1922 as a distinct species, *G. ransomi*. On comparing the measurements given by Chapin[1] (see Table II) with those observed in European and African specimens, it is found that, once more, there is a general agreement. In fact, the only character mentioned by Chapin as distinguishing *ransomi* and *pulchrum* is the greater length of the left spicule in the American form. But, as we have seen, there is good reason for believing that this feature is so variable as to be unworthy of consideration, by itself, as a specific character.

On morphological grounds, therefore, the writer is led to the conclusion that there is not sufficient justification for separating *G. pulchrum* or *G. ransomi* from *G. scutatum*. This view will, doubtless, meet with opposition from those who believe that these forms represent physiologically distinct species or subspecies. But (while the existence of "host-races" or local races is quite possible), unless and until it can be experimentally proved, by those in a position to undertake such investigations, that the form found in one host cannot be transmitted to another host, there appears to be no alternative but to regard all these forms as belonging to one and the same species. It is even possible that certain other supposed species may fall likewise into synonymy.

Through the kindness of Professor Johannes Fibiger, of Copenhagen, the writer has had the opportunity of examining a certain number of specimens of *G. neoplasticum* Fibiger and Ditlevsen, the form believed to be instrumental in the production of cancer in rats. According to its original description,[2] this form differs from *G. pulchrum* chiefly, if not solely, in the length of the left spicule of the male, which is given as only 0·528 mm. The material available for the writer's

[1] Since the preparation of this paper, specimens from buffaloes domesticated in Italy have been received through the courtesy of Dr. Cesare Cappelli of Bologna. The left spicule, in two males, measured 15·8 mm. and 16·8 mm. respectively.

[1] *Proc. U.S. Nat. Mus.* lxii, Art. 10 (1922).

[2] *Mindeskrift for J. Steenstrup*, xxv, Copenhagen (1914).

TABLE III.—MEASUREMENTS OF *GONGYLONEMA NEOPLASTICUM*.

Origin of Material	Brown Rats (*Rattus norvegicus*) or Laboratory Rats,* Denmark		Brown Rats (*R. norvegicus*) Algeria		Laboratory rats,* Denmark.	
Author and date	Fibiger and Ditlevsen, 1914		Seurat, 1916		Baylis, 1925	
	♂	♀	♂	♀	♂	♀
Length	15—20	25—80	10—14	23—92	7·4—11·1	46—61
Maximum thickness	0·11—0·13	0·17—0·326	0·16	0·29	0·16—0·2	0·26—0·36
Anterior end to end of œsophagus	2·8	7·0	2·925	6·4	2·1—2·6	5·1—6·0
,, ,, end of muscular portion of œsophagus		—	0·423	0·736	0·36—0·4	0·66—0·79
,, ,, cervical papillæ		—	0·132	0·192	0·135	0·113—0·16
,, ,, commencement of alæ		—	0·155	0·25	0·15	0·14—0·21
,, ,, nerve-ring		—	0·24	0·36	0·175—0·187	0·2—0·275
,, ,, excretory pore		—	0·42	0·8	0·3—0·35	0·55—0·62
Length of tail	0·165	0·21	0·165	0·36	0·11—0·15	0·25—0·3
Diameter of buccal rim		—		—	0·02—0·0225	0·03
Length of pharynx	—	0·053	0·052	0·08	0·05—0·0625	0·07
Cuticular striations, interval between		—	0·015		0·005—0·0055	0·01—0·017
Length of spicules { left		0·528	0·625		0·59—0·67	
Length of spicules { right		0·093	0·085		0·1—0·112	
Length of accessory piece		—	0·065		0·0625—0·075	
Vulva from posterior end		2·5—7	8·0		3·8—7·4	
Ova, length		0·06	0·056		0·052—0·0625	
,, breadth		0·04	0 035		0·035—0·0375	

* Tame or laboratory rats may, according to Mr. M. A. C. Hinton, of the British Museum (Nat. Hist.) belong to either of the wild species, *Rattus rattus* (the black rat) and *R. norvegicus* (the brown rat), but are more commonly of the latter kind.

TABLE IV.—EXTREME MEASUREMENTS (VARIOUS AUTHORS COMBINED) OF THE FORMS OF *GONGYLONEMA* CONSIDERED.

	*scutatum**		*pulchrum*		*ransomi*		*neoplasticum*	
	♂	♀	♂	♀	♂	♀	♂	♀
Length	30—62	74—145	12 —27·8	37—44·4	23	37	7·4 —20	23—92
Maximum thickness	0·2 —0·36	0·275—0·53	0·14 — 0·215	0·19— 0·35	0·149	0·19	0·11 —0·2	0·17 —0·36
Anterior end to end of œsophagus	5·5 —7·0	6·6 —9·0	3·0 — 5·8	6·0 — 7·3	2·85	4·5	2·1 —2·925	5·1 —7·0
,, ,, ,, of muscular portion of œsophagus	0·5 —0·78	0·7 —0·95	0·4 — 0·54	0·48— 0·7	0·4	0·5	0·36 —0·423	0·66 —0·79
,, ,, ,, cervical papillæ	0·122—0·19	0·113—0·22	0·075— 0·115	0·13— 0·165	0·122	0·145—0·154	0·132	0·113—0·192
,, ,, ,, commencement of alæ	0·16 —0·26	0·19 —0·3	0·1 — 0·165	0·19— 0·24		—	0·15 —0·155	0·14 —0·25
,, ,, ,, nerve-ring	0·3 —0·35	0·25 —0·4	0·29	0·275		—	0·175—0·24	0·2 —0·36
,, ,, ,, excretory pore	0·4 —0·65	0·53 —0·9	0·3 — 0·41	0·46— 0·575		—	0·3 —0·42	0·55 —0·8
Length of tail	0·24 —0·35	0·2 —0·38	0·22 — 0·25	0·185—0·25	0·25	0·2	0·11 —0·165	0·21 —0·36
Diameter of buccal rim	0·0225—0·03		0·025—0·03			—	0·02 —0·03	
Length of pharynx	0·04 —0·075		0·045—0·0625			—	0·05 —0·08	
Cuticular striations, interval between	0·0075—0·0175		0·005—0·013			—	0·005 —0·017	
Length of spicules { left	5·0 —23·0		4·0 —5·8		10·03		0·528 —0·67	
Length of spicules { right	0·12 —0·18		0·084—0·13		0·106—0·13		0·085 —0·112	
Length of accessory piece	0·085 —0·12		0·07 —0·075		0·084		0·0625—0·075	
Vulva from posterior end	2·64 —7·0		1·95 —3·135		1·75		2·5—8·0	
Ova, length	0·05 —0·067		0·052—0·07		0·053—0·058		0·052 —0·0625	
,, breadth	0·025 —0·037		0·03 —0·035		0·031 —0·033		0·035 —0·04	

* This column includes the figures given by Neumann (*Mém. Soc. Zool. France*, vii, 463-473 (1894)), and by Seurat (*Compt. Rend. Soc. Biol.*, Paris, lxxix, 717-742 (1916)), as

study included only five males, all of which came from two rats. In these specimens the length of the left spicule varied between 0·59 mm. and 0·67 mm. It is true that this size is extremely small as compared with that found in the other forms considered in this paper, but it is not unlikely that the study of a large amount of material would reveal greater variation. The male worms available are all very small (7·4—11·1 mm. in length), and this fact may be of some importance.

Careful search has been made for some other morphological character in either sex that would enable *G. neoplasticum* to be definitely separated from the forms found in other hosts, but the results, so far, have been entirely negative. In every character studied the amount of individual variation is so great that the specimens from the rat usually fall between the extremes met with in specimens from other sources. The number and arrangement of the cuticular bosses on the anterior end of the worm are very variable, and prove unreliable as a diagnostic character. The number of caudal papillæ in the male is also variable. In all the specimens from rats in which they could be made out, the number of preanal papillæ appears to be four pairs, as described by Fibiger and Ditlevsen. But Seurat[1] has shown that great variation in this respect occurs in *G. scutatum*, where the number of preanal papillæ on either side may vary between two and eight, and the two sides are frequently asymmetrical.

Cervical papillæ were stated by the describers to be absent in *G. neoplasticum*. This, however, is not the case, as has already been observed by Seurat. Though very inconspicuous, these papillæ are present in the same position as in *G. scutatum*. The form of the spicules and accessory piece (or gubernaculum) is the same in all cases. At first sight it seemed likely that the left spicule might present some difference in shape as well as in length, but it appears that the figure given by Fibiger and Ditlevsen[2] of the tip of this organ is somewhat misleading. It has a rounded tip, as in the figure, but the shaft of the spicule only is shown, the transparent alæ, which make up the greater part of the width, having been omitted. Hence the terminal chitinoid cap of the spicule does not form a knob conspicuously wider than the rest of the spicule, but is similar to that of *G. scutatum*. The tail of the female sometimes appears more pointed in *G. neoplasticum* than in *G. scutatum*, but even this difference is not constant. The eggs show the same amount of variation in shape and size.

In Table III the writer's measurements for *G. neoplasticum* are compared with those given by previous authors. In Table IV the measurements of *G. neoplasticum* are compared with those of *G. scutatum*, *G. pulchrum* and *G. ransomi*, the data given by all authors being combined and only the extremes given. While some of the absolute measurements appear very different, on the whole they form series quite compatible with the ordinary individual variation which may be found within any single species when a sufficiently large number of specimens is studied. It was found that an attempt to express certain of the more important measurements as fractions of the total length indicated no constant ratios, and the amount of variation is so great that this method appears quite unreliable.

It is, therefore, a very difficult question whether *G. neoplasticum* should be considered a distinct species or not. It appears to depend upon the importance to be attached to a single character, limited to the male sex, viz., the length of the left spicule. Many helminthologists would, doubtless, consider this quite sufficient to constitute a "good" species. The writer feels, however, that in view of the amount of variation possible in the forms from other hosts, and until a much larger number of males of *G. neoplasticum* has been examined, the evidence is rather strongly in favour of specific identity. This view does not, of course, exclude the possibility of the existence of a "host-race," or even an incipient species, confined to rodents. As in the other cases previously discussed, the question calls for careful experimental investigation by those able to undertake it.

As regards the nomenclature of the species from domestic animals, if *G. scutatum* (Müller, 1869) is identical with *G. pulchrum* Molin, 1857, it is evident that the latter name has priority. Molin[1] described three other species of *Gongylonema* at the same time as *G. pulchrum*, but only one of these (*G. minimum*) seems certainly to be distinct from it, while the other two (*G. filiforme* and *G. spirale*) have never been redescribed since Molin's paper appeared. There is nothing in the very brief diagnoses of these forms to indicate that they are distinct species, except their hosts, though it cannot be assumed, without further proof, that they are synonyms. In the circumstances, therefore, the most reasonable course appears to be to adopt *pulchrum* as the name of the species from swine, sheep, goats, cattle, and equine animals, with *scutatum* and *ransomi* as synonyms. To this synonymy *neoplasticum* may perhaps have to be added.

In conclusion, if, as has been suggested, all these species are identical, the fact has very interesting and important bearings upon human pathology. On several occasions immature specimens of *Gongylonema* have been found in man in America, and Professor H. B. Ward has suggested that they may belong to the species found in pigs. Further, the worm described from man in Italy by Pane, which Sambon refers, with great probability, to *Gongylonema*, bears a very close resemblance to *G. pulchrum*. It is, therefore, highly probable that, when further examples of the human parasite are discovered and carefully examined, they will prove to belong to the species which we found so abundantly among the domestic animals in Italy. In that case, these domestic animals—sheep, goats, cattle and pigs—will have to be considered as important reservoirs of the parasite, and, if Dr. Sambon's theory receives confirmation, as factors in the spread of carcinoma.

[1] *Compt. rend Soc. Biol.*, Paris, lxxix, 717-742 (1916).
[2] Loc. cit., Plate iv, fig. 30.

[1] *Atti dell' I. R. Istituto Veneto* (3) ii, 216-223, 1 Pl. (1857).

In addition to those gentlemen whose valuable assistance in the matter of material has been acknowledged elsewhere, the writer has great pleasure in expressing his indebtedness to Mr. Frank Ware, F.R.C.V.S., of the Royal Veterinary College, for the loan of various specimens from zebu and buffaloes from India.

SOME NOTES ON THE INSECT INTERMEDIATE HOSTS OF GONGYLONEMA.

By K. G. Blair, B.Sc., F.E.S.

(*By permission of the Trustees of the British Museum.*)

In view of the extremely probable connection between *Gongylonema* and certain forms of cancer a knowledge as detailed and accurate as possible of the life-history of *Gongylonema* is an obvious desideratum. Whether this connection be direct or indirect is immaterial; if we can eliminate *Gongylonema* we can, if not eliminate, at any rate control to a very appreciable extent the incidence of this dread disease, at least of that form of it that follows the ravages of *Gongylonema*.

But if we are to eliminate *Gongylonema* the first essential is to discover any weak points in its developmental phases, points in which it is most susceptible to attack, so that effort may be concentrated upon that period of its life history when attack will be most effective.

Actual records of the association of *Gongylonema* with insects, though not very numerous, and not always correlated with certainty with the mature form and vertebrate host of the worm, clearly indicate that the intervention of an insect host at some period of its life history is essential to the proper development of the worm.

Encysted *Gongylonema* larvæ have been found within the body cavity of many genera of coprophagous beetles, e.g., *Ateuchus*, *Chironitis*, *Onthophagus*, *Gymnopleurus* and *Geotrupes* in Algeria and *Onthophagus* and *Aphodius* in America and in the body cavity of different species of *Blaps*, a genus of tenebrionid beetles. Under experimental conditions encysted larvæ have also been found in the mealworm, the larvæ of another genus of tenebrionid beetles, and in the musculature of different species cockroaches, *Blattella germanica*, *Blatta orientalis* and *Periplaneta americana*.

A brief review of these recorded insect hosts and of their habits may prove suggestive.

Dung Beetles (Fam. Scarabæidæ.)

Ateuchus (or *Scarabæus*) *sacer* L is the well-known sacred beetle, the source of inspiration of the scarab of ancient Egyptian sculpture. Its economy has of recent years been re-investigated and made accessible to the public by the writings of the great French naturalist and observer, the late Jean Henri Fabre. The beetle is a lover of darkness, yet for part of its work the hot sunshine is essential. From the droppings of some large animal such as the cow, horse or camel, he cuts out a mass of dung which he works into a large ball very much larger than himself. This he proceeds to roll about in the sunshine till the outside becomes case-hardened, i.e., baked into a hard shell with which are incorporated grains of sand picked up in the rolling process. When the ball is sufficiently baked it is buried in the earth, the beetle accompanying it. Frequently, this ball is destined merely as a food store for its owner, the beetle now proceeding to gorge and gorge until the food store is exhausted, when he emerges again to collect another one. But in the case of the female beetle some of the balls are prepared not for her own delectation, but for the nourishment of her progeny, an egg being deposited in each and the resulting larvæ feeding upon the contents till only the hard, sand-encrusted shell is left. In this chamber it undergoes its further transformations to emerge in due time as the adult beetle. Dr. Sambon has already discussed the probable reasons for the sanctification of this insect by the Egyptians.[1]

Gymnopleurus, *Onthophagus*, *Chironitis* and *Geotrupes*, all members of the same family, behave in essentially the same way except that the rolling process in the preparation of the food-mass is omitted, a hole being excavated immediately beneath the patch of dung selected and the dung carried down. Frequently, the adult

[1] Not only did the Ancients control the plague by pitting against the plague-carrying rat all its natural enemies—the cat, the ichneumon, the kestrel, the snake, but they availed themselves of like methods in several other cases. Ancient Egypt offers two striking examples: the control of hookworm disease or endemic anæmia by the Dung-Chafer or Sacred Scarab (*Ateuchus sacer*) and that of endemic hæmaturia, or bilharzia disease by the Sacred Ibis (*Ibis æthiopica*).

Hookworm disease was well known to the ancient Egyptians. According to Scheuthauer and Joachim, the famous papyrus Ebers (1550 B.C.) rightly ascribed the disease to an intestinal worm—the Heltu worm; and von Oefele has pointed out that a connection between the disease and the carrying and handling of sand was fully recognized.

The important part played by the Dung-Chafer in the theogony of Egypt is well known. This coprophagus beetle is represented in all monuments from the Delta to the very heart of Nubia, carved of all dimensions out of every possible material, but no doubt you will own that all the theories hitherto advanced to explain its sacredness are very fanciful.

Some years ago I suggested that the extraordinary veneration paid to the Dung-Chafer found an easy, natural and satisfactory explanation in the prevention of hookworm disease. In 1900, whilst carrying out my malaria experiment in the Roman Campagna, I had the opportunity of studying the habits of the sacred dung-beetle and I was struck by the rapidity with which excreta, scarcely dropped, were cut up, rolled into pellets, and buried deeply in the sandy soil. It would be impossible to find a more rapid and efficient method of fecal disposal. I understood then why the scarab had been consecrated and looked upon as a tutelary god. It destroyed the larvæ of the hookworm and thus prevented one of the most fearful plagues of Egypt.

The ancient Egyptian habit of wearing a scarab or scarab-shaped amulet over the heart region, of which every mummy we unwrap gives proof, surely suggests protection against the anæmia-causing hookworm disease and explains the words of the Berlin medical papyrus "Even the amulet maker knows the circulation of the blood." [L. W. Sambon] See this Journal, September, 1, 1908.

beetle is content to feed in the original mass of dung, and only the food supply for the progeny is carried underground. These beetles are usually nocturnal in habits, remaining in the dung or in the earth beneath it during the day, coming up to work or flying in search of pastures new as night falls. *Geotrupes* is familiar to all as the "shard-borne beetle" of Shakespeare, while the passing hum of the door-beetle as he "wheels his droning flight" (Gray) is a characteristic sound of a calm summer evening.

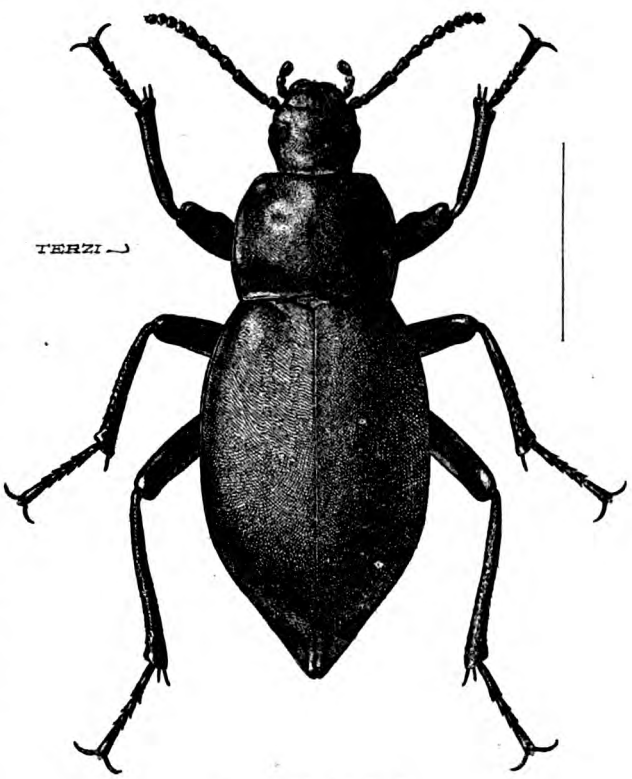
The species of *Aphodius*, generally speaking, are smaller than the dung beetles hitherto considered, and as a rule deposit their eggs in the mass of dung in which the larvæ develop. Some of them are strongly selective in their choice of pabulum, confining their attentions to the dung of particular animals, e.g., cow, sheep, deer, rabbit and so on, while others are much more catholic in their tastes. Many species fly readily in the sunshine and some of them occur at times in enormous numbers.

The larvæ of all these beetles are soft, whitish grubs, with hard brown heads and strong jaws; they lie with the posterior part of the body curled beneath the front portion, and, living as they do, completely surrounded by their food material, their powers of locomotion are very feeble. Their transformations are completed usually in the cavity they have created in the course of their feeding as larvæ, and even the mature beetle remains here for some time while its integuments acquire their full hardness before it is able to break forth from its prison.

Cellar Beetles (Fam. Tenebrionidæ.)

Blaps is a genus of ground-dwelling beetles, black, usually of large or very large size. The elytra or wing-covers are usually produced behind to form a tail-like process, in some species very long, in others scarcely indicated; these processes are nearly always longer in the male than in the female. Wings beneath the wing-covers are wanting, the insects being thus incapable of flight, so that their distribution is more circumscribed, than that of the dung beetle, and when they do occur they are usually found in more or less limited colonies. In England we have two fairly common species, *B. mucronata* Latr. and *B. lethifera* Marsh. The former, popularly known as the cellar-beetle, occurs not uncommonly in cellars and basements even in London. Its life is very imperfectly known, but it is probable that the larva lives mainly on the dung of rats and mice beneath the floors or possibly on fungoid growths that may develop in such situations. *B. lethifera* with us is more usually found in stables and outhouses, the larva probably feeding like that of *B. mucronata* or in accumulations of dung left in odd corners and never properly cleared out. Both these species were found in or about dwelling-houses by Dr. Sambon in Italy, together with two other species that do not occur in this country, viz.: *B. gages* L. and *B. gibba* Cast.

In order to ascertain to which species of *Blaps* any given specimen belongs it is essential to determine the sex. With a single individual this is not always easy except by examination of the genital armature. But when a number are collected from one spot, and presumably all of one species, the sexes can be fairly readily separated by the longer "tails" of the males, by their longer and more slender legs and antennæ, by their more parallel form, and, in many species, by the presence on the underside of a pad of yellow hairs between the first and second segments of the abdomen.



Blaps gibba Cast. ♂

The four species above-mentioned may be separated as follows:—

(1) Tail parallel sided, the tips separated by a distinct notch; size large (40 mm. or nearly); ♂ with ventral hair-pad, tails long (3 to 4 mm.); ♀ with tail about 1 mm. *gages* L.
Tail convergent behind, tips adjacent; size smaller (25 mm. or less) 2.
(2) ♂ with hair-pad; thorax distinctly transverse, the sides rounded, convergent behind the middle 3.
♂ without hair-pad; prothorax small, not much wider than long, or than half the width of the elytra, its sides nearly parallel behind with posterior angles rectangular *mucronata* Latr.
(3) Thorax distinctly narrower than elytra (about ⅔ as wide), upper surface more finely and smoothly punctured; joints 4 to 7 of antennæ fully twice as long as wide (♂) *gibba* Cast.
Thorax nearly as wide as elytra, upper surface more coarsely, elytra asperately, punctured; joints 4 to 7 of antennæ scarcely 1½ times as long as wide *lethifera* Marsh.

The genus is widely distributed in the southern palæarctic region, the species being most numerous in S.W. Asia, thence spreading westwards along both shores of the Mediterranean, a few species penetrating into Central Europe or beyond, while eastwards it reaches Japan.

The larvæ are subcylindrical, moderately hard-shelled grubs of a yellowish colour with a considerable resemblance to the better-known "wire-worms" (larvæ of the skip-jack beetles or Elateridæ). From these they may be distinguished, *inter alia*, by having the first pair of legs, i.e., those immediately behind the head, larger and stronger than the two pairs behind them, by the head being rounder, not so depressed, with the mouth parts free and rather soft in texture, while in the Elateridæ the labium and bases of the maxillæ are strongly chitinized and fused together to form a solid tripartite plate occupying the buccal cavity of the head beneath.

The terminal segment in *Blaps* is flattened above, subtriangular with the apex produced into a small upcurved point; the sides are arcuate, provided with a series of upstanding spinules just within the margin. They are subterranean in habit, and can burrow readily, even through hard sun-baked earth.

The food, both of larvæ and adults, of the Tenebrionidæ was probably originally decaying vegetable matter. Certain genera have acquired importance from an economic standpoint, by developing the habit of eating off the seedlings of growing crops, while others have become dung feeders. Many species appear to have profited by the gregarious habits of man, and many species, especially of *Blaps*, but also of the not distantly allied genera *Akis*, *Ocnera* and *Pimelia* thrive on the outskirts of towns and villages, whilst some, yet more domesticated, invade the dwellings of man and of his cattle.

The adult beetles, on account of their lack of wings, are unable to travel far or quickly in search of food. Unlike the true dung beetles, they are poorly equipped for digging and quite unable to lay up a store of food for their progeny. They dislike the light and hide away by day under stones, under vegetation or rubbish and come out to feed at dusk.

With regard to *Blaps* it is interesting to find that it has always been looked upon with suspicion of harm. The French call it "*Présage mort, Porte-malheur, Sorcière de la mort*"; in Sweden it is regarded as the messenger of pestilence and death; in Germany it is known as the "Totenkäfer," while we call it the churchyard beetle as well as the cellar beetle.

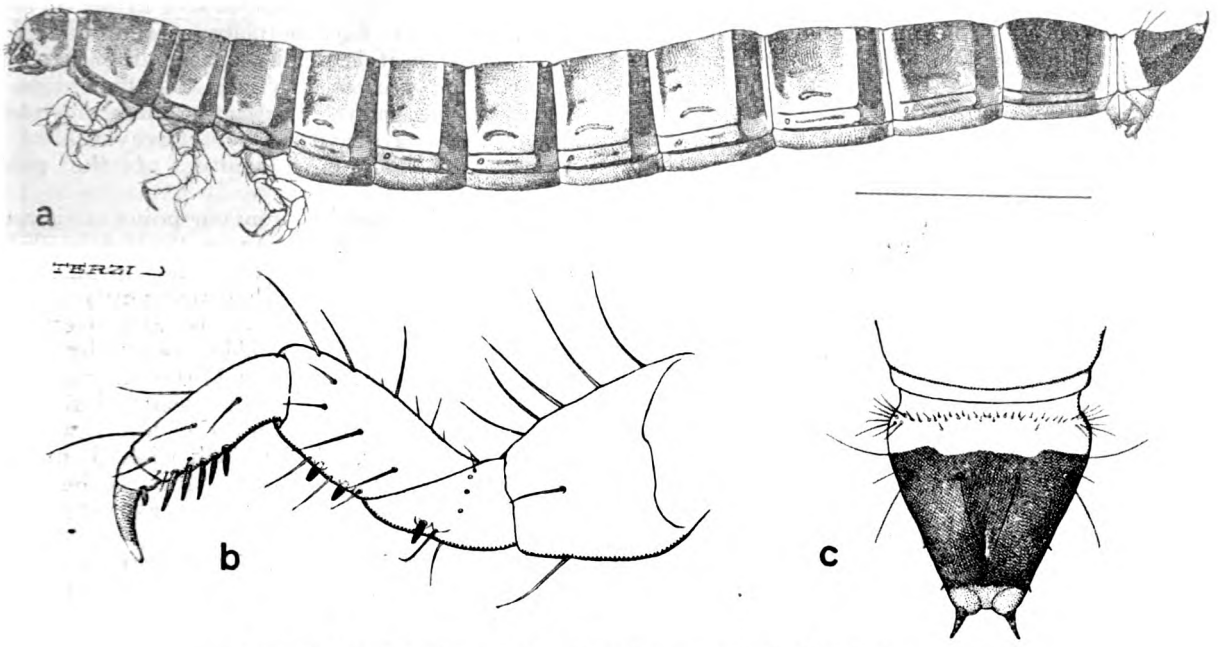
Meal-Worm Beetles.

Tenebrio, another genus of the same family, *Tenebrionidæ*, includes in Europe two common species, *T. molitor* L. and *T. obscurus* F., both found in houses. The beetles themselves are narrower, more parallel-sided than *Blaps*, more depressed, with shorter, more feeble legs, and of a deep mahogany-red, almost chocolate colour. *T. molitor* is not quite so long and narrow as *T. obscurus*, and more or less shiny, whereas the latter is so closely punctured as to appear quite dull and opaque. Their larvæ are the well-known meal-worms occurring everywhere in granaries and bakehouses, and even in ordinary dwelling-houses. They are very similar to the larvæ of *Blaps*, but more slender, with the last segment of the abdomen more conical and terminated by a pair of small spiniform projections.

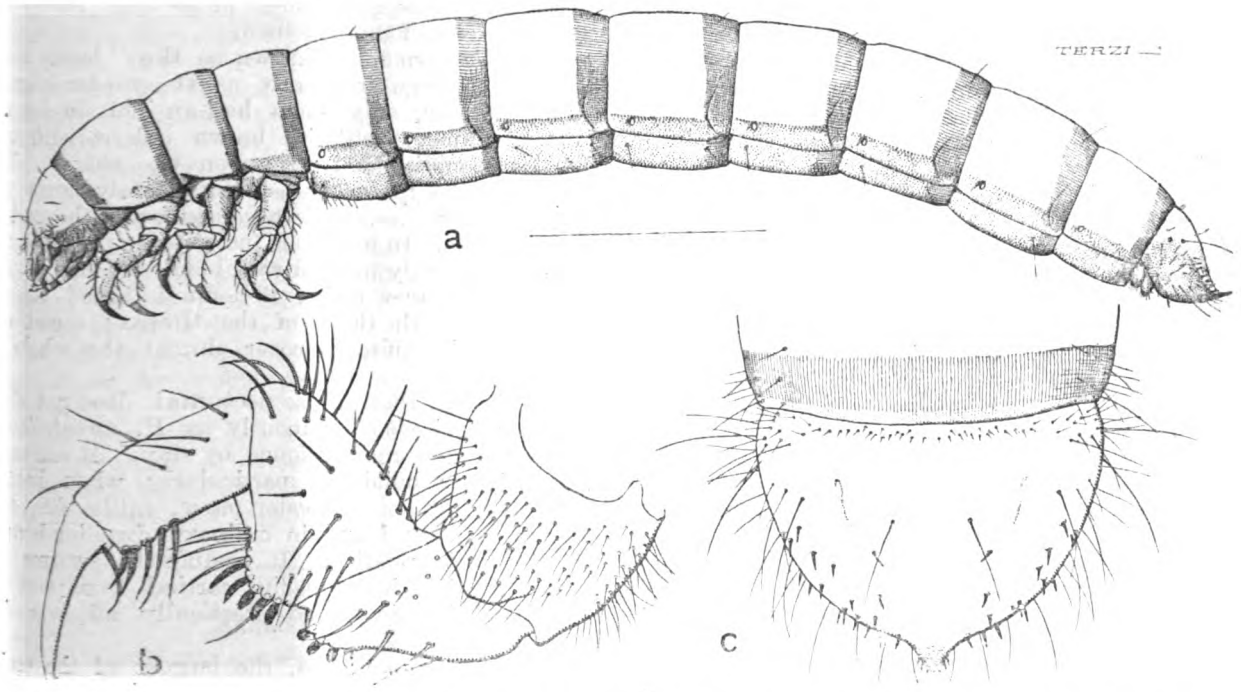
Hence, as regards the known beetle hosts of *Gongylonema*, it is evident that they fall into two categories, viz.: dung feeders and meal feeders. In these insects the *Gongylonema* passes the early stages of the development, presumably after the host has ingested an egg that has been passed out of the alimentary canal of the mammalian host of the mature worm. As regards the dung feeders this egg might be swallowed either in the larval or the adult stage of the beetle host, both stages being dung feeders, though it is possible that the age of the host may be more definitely restricted if the proper development of the worm is to ensue. Having hatched from the egg the larva burrows through the wall of the gut and encysts either in the body cavity or in the musculature of the insect (possibly the situation varies with the species of *Gongylonema*) when transference to a vertebrate host becomes necessary before development can be completed. In the case of small mammals, rats, mice, hedgehogs, &c., and of domestic fowls, this transference presents no difficulty, as the beetle is eaten by the new host, the cyst-wall dissolved, and the worm liberated. In the case of sheep and cattle, too, if the host be one of the smaller dung beetles, e.g., an *Aphodius*, it is readily conceivable that it may be eaten accidentally with grass, though with the larger beetles, *Ateuchus*, *Blaps*, &c., this is less likely. It is still possible that the beetle may be crushed or trodden upon and the encysted worm with the body-contents of the beetle smeared upon the grass or fodder and swallowed by the next comer.

For infection to be contracted by man it is obviously necessary that the encysted worm should be swallowed alive, a state of things that, owing to the nature of man's food, can only occur occasionally or accidentally. It is by no means uncommon for *Tenebrio*, *Blatta*, and particularly some of the smaller "flour" beetles, *Gnathocerus*, *Tribolium*, *Anobium paniceum*, &c., to be found in bread, but normally any encysted *Gongylonema* in such insects would be killed in the process of cooking. If, however, the cooking be incomplete and hasty, as is only too frequently the case, especially in more primitive communities, it is quite conceivable that the encysted worms may survive the operation and resume activity after being swallowed with the food.

In the case of *Tenebrio* it is not so obvious how the egg of *Gongylonema* comes to be swallowed by the beetle larva. The meal-worms in the flour-bin would scarcely be likely to come in contact with human fæces, and thus are not likely to swallow



Larva of *Tenebrio obscurus* Fab. *b* foreleg, *c* terminal abdominal segment.



Larva of *Blaps* sp. incerta. *b* foreleg of larva of *Blaps lethifera*, *c* posterior extremity of *Blaps* sp. inc. seen from above

the eggs from a human source. It is more likely that the eggs so swallowed were passed in the fæces from a rat, mouse, or, possibly, domestic fowl, and these fæces may have been desiccated and disseminated in the course of time. After encysting it may (or may not) be immaterial to the *Gongylonema* whether the meal-worm be eaten by another rat, or, after surviving an attempt at cooking, be eaten by man.

Very probably the investigation of other meal-feeding larvæ, e.g., the beetles mentioned above, as well as lepidopterous larvæ of the genera *Ephestia*, *Pyralis* and *Aglossa*, for larval Nematodes would yield results of value.

Cockroaches.

These insects are broad and flat, usually with two pairs of wings, the upper pair stiff and corneous, protecting the folded under pair. They thus bear some little resemblance to beetles, indeed, the common domestic cockroach, *Blatta orientalis*, is perhaps more familiar under the designation "black-beetle." With the beetles, however, they have, systematically speaking, no relationship whatever; from them they may be recognized by having the head depressed ventrally, completely concealed when at rest beneath the carapace of the prothorax; by the very long and slender antennæ, composed of a large number of joints (in beetles there are normally eleven, sometimes less), by the characteristic neuration of the upper wings, which overlap to some extent instead of meeting in a straight line down the middle of the back as they do in beetles, and by the fan-like folding of the lower wings. These wing characters are not always available as in this group of insects the wings are frequently undeveloped, especially in the female. In *B. orientalis*, for example, the wings in the male are small, not nearly covering the body, while in the female they are reduced to mere rudiments.

In their development also the cockroaches differ widely from the beetles, having what is termed an "incomplete" metamorphosis. That is to say, there is no caterpillar-like or grub-like larval stage, succeeded by a resting pupal or chrysalis stage during which no food is taken, and on the assumption of which the form of the limbs of the adult first becomes externally recognizable, but the young cockroach on hatching from the egg has the long-legged, flattened, active form of the parent insect, differing from it only in its pale colour and in the complete lack of even the rudiments of wings. These organs are developed gradually as external lobes of the second and third thoracic segments, increasing in size with successive moults, until at the last moult, when maturity is reached, their full development, at least in such species as possess fully-developed wings, is attained.

The cockroaches are very general feeders, passing indiscriminately from garbage to material intended for human consumption, whether animal or vegetable in nature, whether cooked or raw, and this habit, in conjunction with the partiality evinced by certain species for human habitations, makes them dangerous agents in the contamination of human food. It is indeed only too common to find them, either in fragments or intact, in bread, soup, or other food actually served up on the table, so that it is readily conceivable that where the cooking process has been insufficient to kill *Gongylonema*, encysted either in their musculature or in the body cavity, the conveyance of the parasite to man is a matter of the greatest facility.

The principal species, from our point of view, are: *B. orientalis* L., the common "black-beetle" of our kitchens. These insects are nocturnal in habits and lovers of warmth. They frequently swarm in incredible numbers in kitchens and rooms kept constantly heated, but hide away by day in crevices, particularly around the kitchen range, so that they are seldom seen, but if the room be entered after dark the floor, walls, furniture, everything, will be black with them. Even by day their presence may frequently be detected by the disgusting, though not very strong, odour that they emit.

This species is dark mahogany-red in colour, so dark indeed as almost to appear black, and nearly an inch in length. The males may be at once recognized by the possession of wings, which cover one half to two-thirds of the abdomen. In the female the wings are mere lobes and leave the abdomen fully exposed. They may frequently be observed carrying the egg capsule projecting from the posterior end of the abdomen.

Blattella germanica, known as the "lesser cockroach," or very frequently as the croton-bug, is much smaller, only about half-an-inch in length, and of a pale, yellowish brown colour with two blackish longtitudinal stripes on the thorax. The wings in the mature insect completely cover the abdomen, in fact, project considerably beyond it in both sexes. In immature individuals the abdomen is rather strongly marked with black or dark brown, arranged in two rather ill-defined broad streaks continuous with those of the thorax; sometimes these streaks unite to cover almost the whole of the abdomen.

This insect, though also nocturnal, does not shun the light quite so assiduously as *B. orientalis*, so that it is more readily found by day. It seems to affect larger buildings, particularly when heated with a system of hot-water pipes, mills, &c., and is not so often found in ordinary dwelling-houses as its larger relative. It frequently swarms on ships, so that it is readily carried from port to port, and is now found practically all over the world.

Periplaneta americana, the largest of the cockroaches mentioned, is nearly one-and-a-half inches in length; of reddish brown colour, not so dark as *B. orientalis*, and the wings completely cover and extend beyond the abdomen. This species also is frequently found on ship-board, and is thus widely distributed in seaport towns.

Possible Insect Hosts of *Gongylonema* in Iceland.

The very limited insect fauna of these regions must obviously narrow down our search for possible hosts of *Gongylonema*. Of such hosts hitherto recorded from other parts of the world the beetles are represented only by the genera *Aphodius* and *Blaps*. *Aphodius lapponum* Gyll. is not uncommon in sheep's dung, while *A. alpinus* Scop. and *A. foetidus* F. have also been recorded, possibly in error for the first-named. This species might be expected therefore to serve as host for the early stages of a *Gongylonema* affecting sheep, goats or reindeer.

There are no published records of any species of *Blaps* or of *Tenebrio* occurring in Iceland, but Dr. Sambon informs me that specimens of *Blaps mucronata* locally captured and of *B. gages* are preserved in the Reykjavik Museum, while it is not improbable that *Tenebrio* may occur in bakehouses.

Blattella germanica was found in some numbers by Dr. Sambon in houses, and on ships in the harbour, while *Periplaneta americana* and *Blatta orientalis* have also been found.

Any of these insects may function as intermediate hosts for a *Gongylonema* occurring in rats and mice, and occasionally securing lodgment in man.

Another semi-domestic insect recently collected by Dr. Sambon and not hitherto recorded from Iceland, though of this also specimens are preserved in the museum, is the carabid beetle, *Pristonychus terricola*, Hbst. This beetle belongs to a family that is strongly predaceous in habit, both in the larval and adult stages. A closely allied species, *Sphodrus leucophthalmus*, L., preys particularly upon *Blaps*, and has been found with it by Dr. Sambon in Italy. What would be the fate of a larval *Gongylonema*, presuming that it were swallowed without injury by one of these predaceous carabidæ, is not certain. There is the possibility that it would have lost the capacity, possessed on its first hatching from the egg, of burrowing through the wall of the intestine in order to seek its proper quarters in the body cavity or musculature, or would perish in the process of digestion.

Seurat, however, has shown that the larvæ of certain Spiruridæ, if ingested, along with their first host, by some small animal which is not their appropriate final host, are capable of re-encystment.

Annotations.

Investigations on the Epidemiology of Hookworm Disease in Colombo. Part I: On the Isolation and Identification of Infective Nematode Larvæ. Part II: Observations on the Viability of the Hookworm Larvæ (L. Fabian Hirst, *Ceylon Journal of Science*, vol i, part i, June 4, 1924).—In part i the available methods for isolating nematode larvæ from soil, sludge and sewage are briefly discussed. Modifications of the Baermann technique for the special purpose of isolating nematode larvæ from gasified sewage effluents and sewage sludges are described. Descriptions are given of three methods for separating infective nematode larvæ from the free-living nematode larvæ found in certain soils. The methods are based upon the reactions of hookworm larvæ to particular environmental stimuli. A new thermotropic reaction of hookworm larvæ is described. In part ii a series of laboratory experiments are described on the length of survival of human hookworm larvæ (*Necator americanus*) in various soils of given composition. In one set of experiments two of these soils were heated sufficiently to destroy nematode larvæ, a shallow layer placed in pans, and mixed with human fæces containing numerous ova. Human hookworm larvæ were recovered after at least 108 days and at most 124 days from the surface of the soil. The numbers of living larvæ were well maintained during the first two months of these experiments, which were carried out under tropical conditions. The length of survival of *N. americanus* larvæ isolated from cultures by Baermann's method was studied in another series of experiments. The larvæ were immersed in various fluids and implanted in pots containing the three soils. Larvæ lived about three months in water and fluid extracts of trench soil. They died out rapidly in salt solution. Cultivated Necator larvæ survived 120 days in the interstices of the unsterilized laterite soil. The human hookworm larvæ died out much more rapidly in soils and fluids maintained at blood heat, than in the same substances at room temperature.

Control of Hookworm Disease in South Alabama (W. G. Smillie, *The Southern Medical Journal*, vol. xvii, No. 7, July, 1924).—Hookworm infection is widely distributed in all ages and classes of people in the sandy coastal plane of South Alabama. Hookworm disease, that is, infection so severe as to be of actual harm to the individual, and so widespread as to be of economic importance to the community, is limited to rural children of school age. It can be almost entirely eradicated from a given country in a single year by mass treatment of the rural school children. This does not require an expensive hookworm campaign, but should be effected through the routine activities of the full-time county health officer and his nurse. The hookworm infection rate will not be reduced by this method of mass treatment. But hookworm infection is never permanently reduced by treatment. Hookworm treatment should be used to control actual hookworm disease. Sanitation should be employed to reduce hookworm infection. Sanitation methods should be begun in conjunction with the hookworm treatment and should be pushed consistently until at least 80 per cent. of the rural homes have sanitary toilets.

Experiments in the Treatment of Hookworm Disease with Carbon-Tetrachlorid and Ascaridol (S. B. Pessoa, *Southern Medical Journal*, vol. xvii, No. 9, September, 1924).—A mixture of carbon tetrachlorid and ascaridol, in a maximum dose of carbon-tetrachlorid, 1 mil, and ascaridol 0·75 mil, removed 94·5 per cent. of the hookworms harboured by a group of twenty patients. A dosage of 0·75 mil of ascaridol, followed in half-an-hour by 1 mil of carbon-tetrachlorid, removed 94·3 per cent. of the hookworms harboured by a group of twenty-eight persons. Carbontetrachlorid is well tolerated by the great majority of persons in doses up to 3 mil, which is the maximum dose used by the author. In some persons the ingestion of this drug, even in small doses (1 mil) produced symptoms attributable to a lesion of the liver. These symptoms may even be those of acute toxic jaundice. Four of the five cases of intoxication which have been noted following of administration of the drug were observed in chronic alcoholics, two of them showed evident signs of hepatic cirrhosis. However, several other alcoholics have been treated who did not show any symptoms of intoxication. No conclusions can be drawn from one case of intoxication in a non-alcoholic patient. Considering that most persons bear the administration of carbon-tetrachlorid well, but that some persons, such as chronic alcoholics, are susceptible to even small doses of this drug, the author thinks it advisable in future experiments to exclude the latter class of persons from treatment with the drug. In suitable cases the carbon-tetrachlorid could be administered in larger doses (2 to 3 mils) with ascaridol in doses of 0·5 mil to 0·75 mil. Such treatment would probably be sufficient to cure. The contra-indicated cases might be treated with chenopodium oil or ascaridol in accordance with the standard method.

Determination of the Resistance of Leukocytes (J. J. Sampson, *Arch. Internal Medicine*, October 15, 1924).—White blood cells recently delivered into the circulation have an increased resistance, excepting, presumably, according to the present criteria of morphology, immature cells such as occur in acute leukemia. In patients who succumb to an infection or intoxication, there is evidence that the increased resistance is less marked than in those patients who are holding the infection or intoxication in check or overcoming it. This partially confirms Mauriac's "Oscillation of Defense," which promises to be an additional factor in arriving at a prognosis in at least some of the acute infectious diseases.

Report of a Fatal Case of Juvenile Diabetic Coma with Insignificant Ketonuria, and with a Large Amount of Acetone in the Spinal Fluid (H. M. Feinblatt, *Arch. Intern. Med.*, October 15, 1924).—In the case of a comatose girl, aged nine years, with the classical symptoms of diabetes mellitus, dating back three weeks, and with a markedly reduced carbon dioxid combining power of the plasma, the urine revealed only a faint trace of acetone and no diacetic acid. Notwithstanding the fact that there was no acetone in the blood, a very large amount of this substance was found in the spinal fluid. Although 110 units of insulin (H. insulin-lily) were administered within a period of twelve hours, there was no reaction at all and the blood sugar level was not in the least affected.

Observations on the Morphology and Life Cycle of Filaria recondita *Grassi* (M. A. Narayan Rao, *Agricultural Research Institute, Pusa. Bulletin*, No. 144, 1923).—Of the numerous dogs brought to the College Hospital, Madras, none was found to harbour microfilaria until December, 1921. Since then seven cases have come under observation, all of them in-patients of the hospital. The microfilaria appeared the same in all cases. Five of the dogs infected were brought to the hospital for other reasons and were kept in contact with the other two cases for periods varying from a fortnight to a month. It is evident, therefore, that the filariasis was acquired after their admission to hospital. The author is of the opinion that the carrier of the disease was culex mosquito.

Abstract.

REPORT OF THE ANKYLOSTOMIASIS INQUIRY IN MADRAS.[1]

By K. S. Mhaskar.

The inquiry was commenced on July 28, 1916, and was closed on January 27, 1923. After studying for a month and a half the methods adopted by Lieut.-Colonel Clayton Lane, I.M.S., in carrying out his ankylostomiasis inquiry in the Darjeeling District, I began work in October, 1916, among the coolies collected at the Nagapatam Emigration Depot. This first portion of the inquiry was completed in March, 1917. The results of the examination of 11,500 coolies showed that 98·6 per cent. of the coolies harbour hookworms.; the infection is endemic; it is universally distributed in the rural areas of the thirteen districts and four States of the southern half of the Presidency. It is slightly less in amount—91·0 per cent.—in the urban areas. The infection is compatible with apparent good health. Sixty and thirty-seven per cent. of the coolies are infected with round-worms and whip-worms respectively. Multiple infections are a common feature.

The chief object of the inquiry at Dindigul and the surrounding villages was to ascertain how far

[1] Abstracted from the *Indian Medical Research Memoirs*, vol. i, No. 1, October, 1924.

propaganda and free medical help can induce the population to adopt sanitary habits; and by endeavouring to rid this area of the infection, to formulate the lines of future field work in the presidency. As no improvement in the sanitary habits of the people was apparent after two years of field campaign and the results were long in coming, the Scientific Advisory Board felt that such a campaign lay outside its scope of research work. This second portion of the inquiry was closed on May 24, 1919. The results of other investigations at Dindigul confirmed the findings of the inquiry at the Negapatam Emigration Depot, and showed that (*a*) the infection is mainly by necators; (*b*) it varies in intensity in the various communities; and (*c*) is on the whole a light one (twenty-two hookworms per person).

The investigations at the Trichinopoly Central Jail were intended to indicate the intensity of the hookworm infection in the districts and the effects of treatment on the general health of the community. Problems in connection with hookworm anthelmintics (in collaboration with Rev. Father J. F. Caius, S.J.) and other problems arising from difficulties experienced in the field were also tackled. After the close of work at Dindigul I was asked to devote myself exclusively to experimental work in this jail. The results of these investigations confirmed the findings of the inquiry at Negapatam Emigration Depot and at Dindigul, showed that the percentage prevalence of *Ankylostomum duodenale* varies between ten and eighty; the highest degree of infection with it, is ten per person in Tanjore district. *A. ceylanicum* infection is absent in southern India. The intensity of hookworm infection varies in the different districts of the presidency; it is highest in Malabar and Tanjore with 103 and 93 hookworms per person respectively; and averages between twenty and forty-one in the districts of Salem, Coimbatore, Trichinopoly, Ramnad, Madura and Tinnevelly. Roundworm and whip-worm infection was found in forty-three and twenty-six per cent. of 6,400 convicts examined. Oxyuris infection was found macroscopically in ninety-nine per cent. of the convicts. Ground-itch and consequent dermatitis are invariably absent. Ankylostomiasis with pronounced anæmia and consequent emaciation is rarely noticed. The presence of occult blood in stools, long after the hookworm infection has been removed, indicates a possible cause of the refractory anæmia of some cases. The hæmoglobin percentage averages 74·0; 91·5 per cent. of the convicts are apparently healthy, the balance of 8·5 per cent. consisting of mild cases of ankylostomiasis. The hæmoglobin percentage bears no clear relationship to the number of hookworms harboured. There is, therefore, no justification for a classification of light, mild and severe infection based on the degree of anæmia. Removal of the infection brings about a gain in body weight. Flies carry with them hookworm ova and larvæ and may thus be the disseminators of the disease. They also carry the round-worm and whip-worm ova. There appears to be some correlation between humidity and intensity of infection—the higher the humidity the greater the infection. The infection is influenced by gross seasonal variations in humidity. Diagnosis of hookworm infection in the host is unreliable if it is based on the presence of occult blood in stools, the degree of anæmia or high œsinophilia percentage. Diagnosis based on the presence of ova and worms in stools is reliable. Of these the first is to be preferred whenever the determination of the degree of the infection is not required. The diagnosis of ova is best made by the "Flotation" method. In the case of post-treatment diagnosis of helminth infections, the diagnosis of ova made after the fourth day of treatment with betanaphthol, thymol, carbon tetrachloride and santonin, is reliable. With chenopodium oil the diagnosis should not be undertaken until the twelfth day of treatment. Hookworm infection is a predisposing factor in bowel complaints and in such generalized infections as influenza. Freedom from infection shortens the period of illness and lessens the average death-rate. Natural elimination of hookworm infection does occur under sanitary conditions; which appreciably lowers the intensity of the infection; such natural elimination is a slow process. It is impossible at present to give an opinion about the duration of life of the hookworm. The variations that occur in the intensity of the infection when the host is kept under sanitary conditions, or when reinfection is influenced by changes in atmospheric humidity, suggest that the duration of life of the worm is probably one that can be counted in months. Natural elimination of hookworm infection (ova and larvæ) in the night-soil occurs within a period of fourteen weeks, and is rapid in every succeeding age-period of the infection. The larvæ do not migrate from the place of development and are commonly found unsheathed in nature. So far as parasitic helminthic infections are concerned, night-soil can safely be used as manure after a period of six months.

The investigations on anthelmintics showed much that was obscure and irrelevant in hookworm treatments.

Current Literature.

THE INDIAN MEDICAL GAZETTE.

Vol. lix, No. 12, December, 1924.

Note on a Herpetomonas Found in the Gut of the Sandfly Phlebotomus Argentipes, *Fed on Kala-azar Patients* (R. Knowles and L. E. Napier).—In ten out of eleven consecutive experiments, female laboratory-bred *P. argentipes*, fed on the parasite-containing blood of kala-azar patients showed typical herpetomonad forms in the fore-gut or mid-gut at the third to the fifth day after the feed. No less than twenty-five out of fifty-six such fed flies showed herpetomonads, and in six instances the infection was a heavy one, although the patient's

blood films had shown only scanty *L. donovani* present. On dissection and examination of 811 control sandflies, including both *P. minutus* and *P. agentipes,* the only natural infections encountered have been once a Rickettsia, three times a Bodo, and once a doubtful spirochæte. Nothing resembling a herpetomonad had been encountered. On dissection and examination of forty-six other control female *P. argentipes* fed upon persons not suffering from kala-azar, no protozoa were found. It is concluded that *L. donovani* passes into its flagellate form in the gut of *P. argentipes* under suitable conditions of atmospheric temperature and humidity. Any further conclusions with regard to the kala-azar transmission problem, however, are at present carefully avoided. What is wanted is further work, which is now in progress, rather than speculation.

Ankylosis of Joints (W. L. Harnett).—Ankylosis of joints are classified into (1) Cases in which the pathological process (disease or injury) started outside the joint; (2) Cases in which the primary process started within the joint, the contracture of surrounding structures being secondary. The comparative rarity of ankylosis as the result of tuberculosis in India is noteworthy. Bony ankylosis and fibrous ankylosis are described and illustrative cases are given.

Canine Leishmaniasis in Bombay (Khan Bahadur C. R. Avari and F. P. Mackie).—A pariah dog was noticed to have a superficial sore near the base of one of its ears. Films were made and leishmania-like parasites were found in fair numbers. The dog was not seen again for some days, and, when caught a week later the small lesion was found to have healed and there only remained a small nodule partly covered by a scab. The nodule was excised and broken up in saline and rubbed into scarifications on the head of a dog and a monkey. No case of leishmanial infection of Indian dogs has been previously recorded, but this case shows that the disease exists in India.

A Note on the Testing of Insulin in India (J. Taylor).—The details of a method used in the standardization of insulin are described. The results of tests of a sample of insulin in tablet form are given, and show that with Indian rabbits a potency approximating to the manufacturers' estimate was obtained. These tests show that although there is a variation in the response of Indian rabbits of mixed breeds, the average result obtained from a series of these rabbits can be relied on. Later, tests have been carried out with further samples of insulin in solution form from English manufacturers which have been found to be of full original potency.

On the Life History of Herpetomonas Muscæ Domesticæ (W. C. Ross and M. Hussain).—The observations carried out show that herpetomonas is a tissue parasite, not an intestinal parasite. The flagellate stage is an ephemeral one, lasting for a period of not more than six hours, and often less. The function of the flagellate stage is one of sexual reproduction. The parasite after entering the fly's intestine in its effective spore stage, penetrates the intestinal wall in the upper part of the intestine, and reaches the loose areolar tissue under the lining membrane of the intestine, in which it divides by fission, multiplies, and grows to maturity. The process of growth in the tissue usually occupys three days, at the end of which period the mature flagellate bores its way back to the lumen of the gut, where a process of sexual conjugation takes place almost at once and cannot usually be observed after a lapse of fifteen minutes after the migration of the parasite. After one or two hours a process of " spore extrusion " takes place, which lasts for about ten minutes. These spores are present in enormous numbers in the lower gut of infected flies, and they have also been observed in N.N.N. cultures from kala-azar cases. The spores undoubtedly constitute the infective stage of the parasite and are resistant to a hostile environment and capable of withstanding exposure. The flagellates themselves have almost all disappeared before reaching the lower gut, and those that remain are almost all degenerate or dead. Fission of flagellates has never been observed during the whole course of these observations.

A Case of Complete Transposition of the Viscera (N. C. Kapur).—A rare case of complete transposition of the viscera is described in a Hindu boy, aged eight years, attending the out-patients' department of the Medical College Hospital for treatment for kala-azar. Palpation of the abdomen revealed a tumor in the right hypochondriac region extending downwards and inwards to about the level of the umbilicus. The liver was felt in the left hypochondrium and was slightly enlarged. He was taken into hospital and X-ray examination showed the heart on the right side of the chest. Skiagrams of the abdomen taken after a bismuth meal showed that the stomach was mainly situated on the right side of the abdomen with its cardiac end under the right cupola of the diaphragm and the duodenale bulb on the left side of the middle line. The cæcum and the ascending colon were found on the left side. The descending and the sigmoid colon were situated on the right side of the abdomen.

Notes on Some Cases of Relapsing Fever (K. V. Raju).—Twenty-nine cases are described of relapsing fever admitted to the Railway Hospital, Hubli, during a local epidemic in August to October 1923. All the patients complained of pains in the back, legs, and all over the body. The disease attacks mostly male adults of the poor and dirty working class. A few cases were seen amongst women, and five cases in children between four and five years old. Many cases could have been mistaken for plague, which was also prevalent at the same time, but were confirmed by diagnosis which showed spirochætes in the blood. The aches and pains persist during the apyrexial period.

Original Communications.

THE INFLUENCE OF CLIMATE AND MALARIA ON YAWS.

By G. C. Ramsay, O.B.E., M.D.Edin., D.T.M.&H.Eng.
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According to Manson-Bahr in "Manson's Tropical Diseases," "Yaws is practically confined to the tropics and sub-tropics and even there is absent at high altitudes, but owing to its great similarity to syphilis and the extent to which these two diseases overlap, it would appear to be impossible to define its exact limits."

In a description of the diseases of Mongalla Captain Cantlie writes: "The statement that yaws does not occur in the mountains or at a higher level than 800 feet (Castellani and Chalmers, page 1537) is refuted by experience here. Cases are very common from the upland mountainous regions around Torit at levels of 1,000 to 5,000 feet or more above sea level."

My own experience in the Cachar district of Assam is that yaws is more prevalent among the hill tribes than it is among the inhabitants on the plains.

The district of Cachar is a low-lying plain broken up by isolated hillocks and surrounded by ranges of hills varying from 2,000 to 6,000 feet in height.

The climate is characterized by excessive humidity and is markedly oppressive during the monsoon season.

The hottest months are from May to October, with an average mean temperature of about eighty-three degrees, the coldest month being January, with a mean of about sixty-five degrees.

The average rainfall is slightly over 100 inches, with liability to floods from June to October.

The lesions of yaws as seen on the plains and foot-hills during the warm, steamy weather are typically text-book in the primary and secondary stages.

The extra-genital mother yaw, the minute yellow-pointed papular eruption, the furfuraceous desquamation, the warty ring-worm or circinate yaws and the foot lesions (crab yaws) are as typical in Cachar as in other yaw-infected countries.

The effect of climate on these lesions is remarkable: during the cold season on the plains it is a very rare occurrence to see frambœsial patients presenting typical yellow-crusted excrescences, but condylomatous-like lesions in the warm, moist regions of the axilla and between the nates, chronic dermatitis of the hands, desquamating and worm-eaten-like lesions of the soles of the feet and occasionally painful joints all liable to be mistaken as syphilitic are what is usually seen.

As soon as the weather becomes warmer the characteristic yellow-crusted yaws may reappear with, on the advent of the warm, rainy season, the painful plantar lesions.

The same phenomena are evident amongst the surrounding hill tribes, the higher up the hills a yaw-infected person resides the more atypical does his disease become, but when these yaw-infected hill cases come down to reside on the plains or lower ranges of the hills during the warm monsoon season the true nature of their disease is at once apparent by the development of the typical sulphur yellow-crusted excrescence which is the pathognomonic lesion of frambœsia.

The effect of climate giving the lesions of frambœsia a syphilitic appearance is doubtless one of the principal reasons for diagnostic errors in colder latitudes.

Heat and moisture, but principally the former, appear to be the main factors in producing the characteristic lesions of frambœsia, for the cooler the climate the more do yaws and syphilis resemble each other.

It is when we come to the much-debated question of tertiary and quaternary lesions that Cachar apparently differs from yaw-infected regions like Ceylon and Fiji.

In an experience of over 1,000 cases, tertiary lesions, with the exception of chronic dermatitis of the hands and desquamation, exfoliation and pitted worm-eaten-like appearances of the soles of the feet, are comparatively uncommon.

Superadded infection of ulcers with Vincent's bacilli and Schaudinn's spirochætes converting the characteristics of the frambœsial ulcer into those of tropical sloughing phagedæna with occasional serious sequelæ is by no means rare.

Arthritis is seen in about three per cent. of the tertiary cases, the interphalangeal joints of the fingers being most frequently involved, but bone lesions (periostitis) I have only seen in six cases and on two occasions juxta-articular nodules were seen in patients with a history, but no other signs of yaws.

Gangosa, goundou and cases of neuro-frambœsia (?) (Harper, Fiji) have not been seen in this yaw-infected community.

It is a very noticeable fact that in Cachar the tertiary lesions of frambœsia predominate amongst the residents on the cooler slopes of the surrounding hills and not on the warmer malarious plains.

Climate *per se* fails to explain this anomaly, for severe tertiary lesions are, according to Manson-Bahr and Spittel, extremely prevalent in the much warmer climates of Fiji and Ceylon.

When investigating the reasons for the comparative mildness of tertiary syphilis and the absence of para-syphilitic affections in this district, it appeared to me that repeated malarial infection might be the possible explanation, for coolies imported from a non-malarious district usually appear to contract a much more severe type of syphilis than those born and brought up locally.

The question of racial immunity I have carefully considered, but racial immunity apparently varies with the degree of malaria present in a district and the extent to which a person has become immunized by plasmodia.

Theories such as Fournier's and Levaditi and Marie's dermatropic and neurotropic strains of

Spironema pallida fail in my opinion as far as Cachar is concerned, for cases of neuro-syphilis have been contracted in this province by unacclimatized Europeans from apparently dematropic types of Aryan syphilis.

I am well aware that statements are to be found in text-books contrary to my own experience. In the chapter on syphilis in Thomson and Miles' "Manual of Surgery" we read that malarial and other fevers and the conditions attending life in tropical countries from the debility which they cause tend to aggravate and prolong the disease, which then assumes the characters of what has been called malignant syphilis.

I agree if these statements refer to the complications liable to result from superadded secondary sepsis and the organisms of tropical sloughing phagedæna, but as regards severe tertiary lesions (excepting possibly syphilitic aortitis) my experience has been that one sees more in the average out-patient department of an English hospital in a few days than one sees in this district in a year, and my experience is shared not only by those with whom I have discussed this subject in Assam, but in other parts of India.

On searching the literature on frambœsia I was interested to find that my own observations were by no means new, for Powell, in his article on "Yaws in India," which he read before the Dermatological Society of Great Britain and Ireland in 1896, remarks on the effect of pyrexia on frambœsia.

He writes: "One of the most striking characteristics of frambœsia is the disappearance of the eruption during or after a febrile attack. So remarkable is this that the coolies themselves observe it and usually mention the fact when describing the disease to an inquirer. The cases in which malaria is the curative agent are so numerous that I shall only refer to some of the most recent."

He then mentions cases of yaws where frambœsial eruptions subsided after contracting severe remittent fever and again remarks that yaws is most prevalent in gardens where the incidence of malaria is least.

Powell, however, did not confine his belief entirely to malaria, but believed fever due to other causes has also a beneficial effect and in his conclusions on the effect of pyrexia, writes, "The fever to produce satisfactory results should be of some days' duration."

From Powell's observations, from my own investigations from the fact that Fiji is non-malarious, Ceylon (I am informed) very slightly so, from the fact that tertiary yaws in Cachar predominate on the cooler and less malarious hills, it would seem a feasible conclusion that the prevalence and severity of tertiary frambœsial lesions depends upon the absence, incidence and degree of malarial infection in a yaw-infected region.

One naturally asks in what way does malaria protect?

Are antibodies formed by plasmodia against the toxins of spironemata or can these phenomena be explained on the basis of "protein shock therapy?"

"Protein shock" is, I believe the commonly accepted explanation of the Vienna treatment of general paralysis of the insane by plasmodia.

When discussing these observations recently in England, a distinguished London bacteriologist with a tropical experience, made the interesting remark that the rarity of enteric fever amongst indigenous communities in the tropics might possibly be explained on the same basis.

In the meantime I trust that other workers in other yaw-infected regions will publish their unbiased opinions.

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THE TREATMENT OF HÆMOGLOBINURIC FEVER WITH CAFFEINE SODIO-BENZOATE.

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AND
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IN the symptomatic treatment of hæmoglobinuric fever three prominent conditions must be considered, namely (1) kidney lesions; (2) the cardiac weakness; and (3) the nervous condition. Having in mind these three cardinal points, we have adopted a special line of treatment.

At the present time we are in a position to state that during the past eight months all our hæmoglobinuric fever patients admitted to the hospital, twelve in number, have been successfully cured. It is not our purpose to attribute a specific value to this plan of treatment, but simply to report the result of our experience with these cases. Two of the more severe cases will be fully reported.

There are few conditions in tropical pathology which require greater skill on the part of the physician than the treatment of a case of hæmoglobinuric fever. The basis of the plan of treatment recommended by us consists in the hypodermic administration of caffeine sodio-benzoate. About two years ago one of us was treating a severe case of acute catarrhal jaundice when it was found that cardiac stimulation became necessary, and for this purpose caffeine sodio-benzoate was the stimulant selected. With its administration the circulation of the patient decidedly improved, and what was particularly impressive was the rapidity with which the skin cleared up from its icteroid hue and the bile from the urine. These results appeared on the fourth day following the daily administration of

three grains of caffeine sodio-benzoate hypodermically.

Caffeine sodio-benzoate is an official preparation of the U.S. Pharmacopœia. Physiologically it is not only a general tonic but a cardiac and renal stimulant as well. According to Hare, caffeine increases diuresis by causing dilatation of the renal vessels, particularly in the glomerules, and it further prevents the absorptive action of the tubules. It also exerts a direct stimulating influence on the secretory epithelium of the kidneys. Upon the tissue waste the drug acts as a depressant and therefore conserves tissue.

Recently we have been able to demonstrate experimentally in our laboratory that caffeine sodio-benzoate also possesses anti-hæmolytic properties, which may explain the good results obtained by us in our treatment of hæmoglobinuric fever patients.

The drug is not supposed to supply the normal anti-hæmolytic substance of the blood, if this be at fault in blackwater fever and paroxysmal hæmoglobinuria, but nevertheless it tends to prevent further hæmolysis.

The following technique was used to demonstrate *in vitro* the anti-hæmolytic power of the drug. Eleven separate solutions of caffeine sodio-benzoate were made in isotonic solution of sodium chloride. The degrees of dilution varied in strength from 1 to 20 milligrammes of the drug to each c.c. of sodium chloride solution. Anti-human hæmolytic amboceptor was used in the test, and also complement previously titrated with a 10 per cent. emulsion of human red blood cells. To each test tube was added 1 c.c. of the different strengths of the solution of caffeine sodio-benzoate, 1 unit each of amboceptor and of complement, and 0·1 of the suspension of red blood cells. Sufficient saline solution was then added to make 3 c.c. in each test tube. Two control test tubes were prepared in the same way, omitting only the caffeine sodio-benzoate, and all were incubated in a water bath at 37½° C. for three hours. The results are given in the following table:—

Test tubes	Strength of sol. caff. and sod.-benzoate	Results
1 (Control)	0·000	Total hæmolysis
2	0·001	Medium hæmolysis
3	0·002	,, ,,
4	0·003	,, ,,
5	0·004	,, ,,
6	0·005	,, ,,
7	0·006	Slight ,,
8	0·007	,, ,,
9	0·008	,, ,,
10	0·009	No apparent hæmolysis
11	0·010	,, ,,
12	0·020	No hæmolysis at all
13 (Control)	0·000	Total hæmolysis

It will be noted that tubes 1 and 13 were the controls, and the hæmolysis was complete; tubes 2 to 6 showed medium hæmolysis; tubes 7 to 9 slight hæmolysis; tubes 11 and 12 no hæmolysis. Similar experiments were made with solutions of sodium benzoate and plain caffeine respectively, and the results were the same as those produced by the combination of caffeine sodio-benzoate. It appears, therefore, that both sodio-benzoate and caffeine possess the anti-hæmolytic properties. Clinically we have observed that the combination of these two drugs yields better results than the administration of either one separately, and hence we have adopted for treatment the caffeine sodio-benzoate.

We have a complete record of twelve cases of hæmoglobinuric fever; five of them were true blackwater fever and the remaining seven were probably cases of quinine hæmoglobinuria. The following are reports of two severe cases of blackwater fever which terminated in recovery:—

Case No. 1.—B. A., Costa Rican labourer, 23 years of age, had been suffering off and on with attacks of chills and fever for three months previous to his admission to the hospital. During this time he had been taking 10 grains of quinine sulphate three times daily. He was admitted to the hospital at 4 p.m. on July 7, 1924, when he was suffering with a chill which lasted 45 minutes. He stated that he had had persistent vomiting and had passed bloody urine for the past 14 hours. The skin and sclera were very yellow. The pulse rate, 127 per minute, was soft and irregular, respirations 34, and temperature 104° F. in the axilla. The lungs were negative but the liver and spleen were palpable. Hæmoglobin was 30 per cent. and the red cell count 2,100,000.

An enteroclysis with glucose and sodium bicarbonate was prescribed, and he was given a hypodermic injection of caffeine sodio-benzoate. His nourishment was restricted to iced lemonade. Vomiting was persistent and the stomach contents bile-stained. At 7 p.m. the pulse rate and temperature remained about the same, and he passed 275 c.c. of port wine-coloured urine. He was very restless and a quarter of a grain of morphine was given, after which the vomiting ceased, and the patient rested until 5 a.m. the next morning. At 8 a.m., July 8, temperature was 103° F., pulse 118, and he passed 300 c.c. of dark red urine. Three grains of caffeine sodio-benzoate were given hypodermically and the rectal instillations continued. At 7 p.m. that day his temperature rose to 104½° F. and the pulse rate to 142. He complained of pain in the back and severe headache and no urine had been voided for nine hours. During the night he had had two bile-stained stools. The caffeine sodio-benzoate hypodermically was repeated. At 8 p.m. the temperature dropped to 100° F., and he passed 600 c.c. of yellow clouded urine. His condition gradually improved, and on the morning of the 12th his temperature became normal and the urine was of a dark yellow colour.

The injections of caffeine sodio-benzoate were continued once a day until the 16th, on which date the urine was clear and the icterus of the skin had disappeared. The patient was then ordered quinine hydrochloride by mouth, grains 10, three times daily. He was discharged from the hospital in good condition on July 27.

Case No. 2.—R. G., age 38, Costa Rican labourer, was admitted to the hospital on August

29, 1924, at 8 a.m. He was in such a weakened condition and confused state of mind that no history of the illness could be obtained. The temperature was 103° F. in the axilla, pulse 127, and respirations 27. The skin and conjunctiva were of a deep lemon colour, his breath foul, tongue heavily coated and of a dark yellowish hue. The heart sounds were weak and irregular, the lungs apparently normal, and the spleen could be palpated five fingers breadth below the costal margin. The liver was somewhat enlarged and sensitive on palpation. Hiccough and vomiting were very persistent and the patient's clothing was stained with bloody urine. The blood examination proved negative for parasites, the hæmoglobin showed 20 per cent., and the red cell count 2,250,000. Three grains of caffeine sodio-benzoate were given hypodermically and a cleansing enema ordered, which resulted in a large quantity of hard bile-stained fæcal matter. Rectal instillations with glucose and sodium bicarbonate were begun.

At 11 p.m. that night the patient voided 40 c.c. of black urine. The vomiting and hiccoughs persisted until 3 a.m. the following morning, when the patient fell asleep. In the morning the patient was almost comatose, though the temperature was only 99½° F. An intravenous injection of three grains of caffeine sodio-benzoate was given at 9.45 a.m. The patient then voided 185 c.c. of port-wine coloured urine, his mind cleared, and he complained of thirst and severe headache. Iced lemonade was ordered but was not retained. An ice bag was applied to the abdomen, and subsequently lemonade and white rock water were given and partly retained. On the next day the temperature became normal. At 9 a.m. he voided 500 c.c. of dark red urine, hiccoughs and vomiting had ceased, patient felt hungry and soft diet was ordered. He continued in this condition until September 3, passing dark-coloured urine, and complained occasionally of headaches. On September 4 at 1 p.m. he had a chill, the temperature rose to 104° F., and he voided 250 c.c. of dark red urine. Tertian malaria parasites were found in the blood at this time. The previous treatment was again instituted, and the following day, September 5, at 6 a.m., the temperature became normal and he voided 200 c.c. of clear urine. On this date the patient was ordered quinine hydrochloride, 10 grains three times daily, by mouth, and the hypodermic of three grains of caffeine and sodio-benzoate were continued daily until September 9, at which time the skin had lost its icteroid colour. He was discharged in good condition on September 12.

At the beginning of our observations we gave the caffeine and sodium-benzoate intravenously, but patients always complained of severe headache immediately after the injection, and it was then decided to administer it intramuscularly except in depressed cases with weak circulation, when it was given intravenously.

The following is the routine method we have adopted in treating these cases. This of course may be varied to meet the indications of each individual. No quinine is to be given unless the parasites are found and then only after the patient's urine has become normal. The temperature is controlled by cold sponges and the application of an ice cap to the head. Purgatives are not advisable during the acute attack, and cleansing enemas are to be preferred. These should be followed by an enteroclysis of a solution containing 2 per cent. of sodium bicarbonate and 1 per cent. of glucose, administered very slowly (from 40 to 50 drops per minute). This is kept up for three hours at a time, with equal intervals of rest, until the urine is voided more or less normally as to quantity and quality. Caffeine sodio-benzoate (U.S.P.), grains 3, is given intramuscularly twice daily; the first injection early in the morning and the second at 4 p.m., so that it will interfere with sleep as little as possible. If after the seventh day the patient still remains much jaundiced, the caffeine sodio-benzoate can be continued once daily until the twelfth day.

We have found that vomiting and hiccough could best be controlled by a single hypodermic injection of morphine and atropine, which also acts as a nerve sedative. Thirst is generally controlled by the enteroclysis, but in very severe cases a hypodermoclysis is recommended. During the first three days of the attack the diet is restricted to liquid gelatine, soda water, lemonade, or plain Vichy water. When the vomiting ceases milk may be added to the diet.

THE ÆTIOLOGY OF BLACKWATER FEVER.[1]

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What, then, do we know of the particular relation of light to hæmoglobin? Space only allows a scanty account.

Chemically.—Since the work of Wilstatter and Stoll was confirmed, it is now established that chlorophyll and hæmoglobin are closely related—their enormous molecules having as a common base the four-pyrrol ring combination—ætio-porphyrin—a remarkable chemical structure containing by weight 372 parts of carbon to 92 of hydrogen and nitrogen. In chlorophyll one atom of magnesium gives it its colour and unique endowment for transforming light into chemical energy. In hæmoglobin an atom of iron likewise endows it with its specific power of absorbing and releasing oxygen, also a primary life endowment for animal organisms.

Evolutionally.—The work of Fulton on "Anima Chlorophyll" [11], together with the evidence from other researches collected by him, shows a very strong probability that hæmoglobin originated from chlorophyll and was gradually adapted in the course of evolution to its specific purpose in the higher

[1] Continued from The Journal of Tropical Medicine and Hygiene, December 15, 1924, pp. 333-336.

orders, and, as we have seen, is at its highest in the mammalia.

Physiologically.—Though diagrams showing the portions of the visible spectrum absorbed by hæmoglobin, oxy and reduced, have been for many years included in the textbooks, no study had up till recently been directed to discovering the effects of light so absorbed. This though we have had from the time when we began to observe frequent ocular and personal demonstration of the effects of different exposures to light upon the skin—an effect which contains an undeniable suggestion. Grotthus's law states that "light must be absorbed in order to produce an effect," so light which is absorbed must produce an effect. To quote Bayliss: "Something must happen to the substance, it may be merely warmed, or other forms of energy—chemical, electrical, and so on—make their appearance."

Light Converted to Heat by Blood Absorption.

It is now accepted that while ultra-violet rays from the sun do not penetrate the skin and reach the blood, the longer visible ones do. Gauvain states that the fact has been discovered by Sonne that "the visible rays which are absorbed by the blood are converted to heat." Accepting this, there is nothing to show that it is the whole story or the end of the story as regards heat. Leonard Hill says: "The luminous rays penetrate and are absorbed by the blood and there changed into heat rays, and *probably also effecting changes of a nature as yet unknown*" [12].

In September, 1923, in recording the temperatures of ten pedigree Friesland cattle in this district preparatory to making the tuberculin test, an interesting point was noted and casually mentioned by a veterinary friend. I asked for the figures and a complete table was submitted to me covering five days, two pre- and three post-test. Six of the animals were kept inside during the first day of the pre-test period, while four were not, but were allowed to graze near the homestead. They were not chased and heated by exercise when brought in for temperaturing, a point I specially inquired about. The temperatures of all were taken at 8 a.m., noon, 3 p.m., 5 p.m., and 8 p.m. on September 9. The noon, 3 p.m., and 5 p.m. temperatures of the two lots differed considerably, that of those exposed to the sun being much higher, and as some alarm was felt they were kept inside the following day, with the result that their temperatures showed no difference to that of the others. The temperatures of September 9, in the lot exposed to the sun, at noon, 3 p.m. and 5 p.m., averaged 103·3, that of those kept inside 100·3.

The extent of the rise in temperature in the sun was hardly credible, and naturally I examined the whole table closely, and it was quite consistent otherwise. How is such a rise in thick-skinned bovines to be explained? Breinl found rectal temperatures in man, on walking in the sun, of over 103° F. We know that the great majority of chemical reactions are accelerated by heat, and that there is for most an optimum temperature. "In chemical action there is both absorption and liberation of heat" (Jago).

My experience of the very marked benefits of hospitalization of patients in this country leads me to attribute this to the exclusion of light—and heat—along with the direct treatment received by quinine, and the rest in bed.

For the last three years I have been preaching the necessity of wearing large tinted spectacles of a greenish yellow colour, because I know from experience how enormously they save my nervous energy. Many people have followed my advice and adopted the habit. With remarkable consistency after a first experience, the remark has been made, entirely spontaneously, "You don't feel the heat of the sun so much when wearing them." Remembering the retinal blood sponge, this is not to be wondered at.

An amateur photographic friend tells me that he has tested these glasses, and found that it took 5½ times as long with one side of such spectacles and six times with the other to take a print compared with the ordinary method. I have not confirmed this, but the difference he makes is striking. Assuming that he is only to some extent correct, it is a fact which is easily verifiable that with a reduction of light the sharpness of definition of objects (with plain coloured glass) is *increased* considerably when wearing them in direct sunlight here.

I mention such facts in order to draw particular attention to the eye route. There is the natural light-curtain, the iris, responding continually and insensibly to light variations. I have been amused often to watch the unconscious reflex screwing of the eyebrows and puckering of the skin round the eye in persons who say the light does not worry them and contrasted it with the effect when wearing these chlorophyll-tinted glasses. They usually admit that they feel they "can open their eyes better" then.

Other Effects of Light Absorption.

In addition to its conversion to heat, however, Bayliss, quoting various workers, shows that "light can be stored by Hb": "Hartridge and Hill calculate from . . . what this amount is, and find that it is very considerable, in fact greater than that of any similar photo-chemical reaction with the exception of that of the chlorophyll system." "They find that the infra-red absorption is considerable in this region, which has great radiation energy."

The words of this great master, who has just passed—Sir William Bayliss—are: "It is perfectly clear that light acting on the skin produces something which must pass into the blood and be carried through the whole body" [13].

If the generalization of the liver cells representing green leaf cells be approximately correct, then looking to the synthesis of carbohydrates by the latter and the activity of light absorption by hæmoglobin, taking a very long shot one might suggest that this

light absorbed may have to do with the glycogenic function of the liver.

This is by the way, however.

Regarding the similarities in principle of the action of various lengths of electro-magnetic rays I must take the work on this point as read, it is impossible to detail it here. If the action of X-rays is indeed comparable but of course in degree infinitely greater and more rapid than that of sunlight, then the remarks by Mottram of the Research Department of the Radium Institute are *apropos*: "Many attempts have been made to detect chemical changes in irradiated tissues and in the various substances of which they are composed; in the vast majority of cases no chemical change has been detected, or only insignificant alterations. In contrast to these negative results, the evidence of physical changes is abundant; I refer more particularly to alterations in colloidal state . . . I refer to alterations in permeability of membranes and to the precipitation of colloidal solutions and suspensions" [28].

Clinical Histories Regarding Light Exposure.

At this point I desire to quote, besides those of onset in my preceding paper on blackwater, some other cases which, borne in mind, form useful pegs for the consideration of light energy acting, either slowly, as a photo-thermal or photo-chemical reaction, and secondly, by means of an intermediary substance with peculiar catalytic-like powers, acting with great rapidity.

The case described as the worst case of blackwater I ever saw, of bronze hue when first seen, was a man, a farmer, of strong physique, about 30 years of age, on the day previous to being taken ill he had been exposed to the November sun (Dec. 21, midsummer), for 14 hours sitting on a maize planter. Extra exposure to sun has occurred in many cases of blackwater just before onset. This case was one of those which first led me definitely to suspect some light reaction. Jackson quotes two remarkable cases in which the blackwater developed on the very day of return to the endemic area; one of these had scarcely reached it. He states that these could be multiplied from the practices of medical officers working in highly malarial (? endemic blackwater) districts.

A remarkable case was that of Mrs. V., who left the Shamva Mine, Southern Rhodesia, for a visit to England. Her stay there lasted four months, during which time she was in good health, but on her arrival in Salisbury after a train journey of four days from Cape Town, *en route* for Shamva, she developed blackwater. (Shamva district is a valley conforming to the type where the malignant tertian parasite is rife, 3,200 feet above sea-level.)

Another case illustrating this was that of T. H., history as follows: Five years in Nyasaland, which is highly malarious; furlough for a year in the Cape, a non-malarious territory as before stated, good health; return to Nyasaland; on the day of arrival blackwater, and death three days later. In these cases the blackwater developed after a prolonged residence in a non-malarious country, as even T. H. had not returned to Nyasaland sufficiently long to allow of an incubation period of blackwater [14].

Such cases, excluding the possibility of being due to a reinfection, as they do, appear to suggest a climatic factor. What influence, climatic and dynamic, it would seem, can that be? It would appear in Jackson's two cases to be an immediate reaction, yet dependent on previous residence also.

It is well known that blackwater occurs in persons from endemic areas on a change of even a short distance, especially if the new locality be cooler to the extent of being bracing only. Cases occur frequently on arrival in England, generally within a week. Manson saw a case occurring 9½ months after leaving Africa, and I have had a verbal report of one occurring 18 months after leaving Mesopotamia. Such cases as these could not be due to a photo-chemical reaction due to "light storage." The erratic onset of blackwater bears some similarity to the onset of hæmatoporphyrinuria in persons who have been taking sulphonal and the delayed jaundice in those exposed to other chemicals (Willcox). "The patients have often taken the drug (sulphonal) for months or years with apparent impunity prior to the development of hæmatoporphyrinuria" (Garrod).

Racial Immunity or Merely Colour.

There is the susceptibility of whites to blackwater and the immunity, not absolute, of negroes. Two cases in negroes have occurred in my experience. One was fatal and I made a post-mortem examination. All the tissues were saffron-tinted and the appearances typical. Mulattoes, Eurasians and Eurafricans, Chinese, Greeks, &c., are subject, though possibly to a less degree than blondes.

We have a check on this "racial immunity" statement. For many years I have wondered why the townsman, or modern cave-dweller, in his office from 9 a.m. till 4 p.m. during the period of strong sun, was immune also, to the same degree almost as the negro. His race and colour of skin are the same as those of his country brother, who, exposed to fierce light, gets blackwater. True, the latter also gets malaria to a greater degree, but the discordance is not of the absolute character which occurs with blackwater.

Towns often swarm with anophelines. Grassi [15] has pointed out recently at Rome two definite incongruities between the incidence of malaria and the opportunities of infection. Why do also the vast majority of attacks of malaria—I am speaking from my own experience—come on between the hours of 11 a.m. and 4 p.m.? The type here is, of course, the subtertian. There are other questions also to be asked, but space forbids. Hess has shown that there is a negro susceptibility to rickets. "In New York the milk for the negro babies was supplied from the same dairies as the milk for the white children, yet the negroes developed rickets out of all proportion to the others" [16]. By means of

experiments on white and black rats and local coverings in the human patients, he showed that the action of light was withheld by black colour.

"Light-Receptors."

Retinal.—Let us turn again to some more general evidence. It can hardly be necessary to call attention to the light-receptors which must be assumed in the retinal function. We have also heat receptors in the skin which quickly warn us of the approach of excess. The functioning of the retina is so automatic that it only warns us of blinding glare—it takes no account which can be sensed of the effect of continuous absorption of light of widely varying intensity. The iris light curtain already mentioned is also automatic, but in such intensities as here it is probably inadequate. The negro's iris is so dark that it is difficult to distinguish it from the pupil. Even plants use only a fraction of direct sunlight, the majority about ten or twelve per cent. only, rising as high as 35 per cent. as a maximum in *Helianthus annus* and the cotton plant [17]. Everyone knows how plants wilt in the hottest hours of the day—the chloroplasts retreat to the side of the cell further from the sun.

Light Receptors—Cutaneous—in Lower Orders and (?) in Man.—Jelly fish, certain fishes, amphibians, and the chameleon reptile possess a "chromatic function" by which they quickly adapt their own colour scheme to that of their surroundings. The skin colour of the human race varies, being broadly darker towards the equator. Exceptions to the rule have been adduced to show that they upset the *à priori* suggestion of protection from the actinic rays. Closer examination, however, of the circumstances upholds the principle if not the first and more crude generality.

In speaking of actinic rays it is true that much the most chemically active are those beyond the visible spectrum—known as ultra-violet—but it must be remembered that the whole range of the spectrum, including the infra-red, is, though to a less degree, chemically active. (See diagrams in textbooks.) At the Royal Society in 1922 "Dr. Trevan gave an account of experiments on colour changes in frogs under the action of light. It was easy to turn a frog from dark black to yellow in the course of a few hours. The frog that had been exposed to light was definitely more susceptible to digitalis than the frog which had been kept in the dark. Frogs which had been kept in the light were more susceptible also to quinine. It was possible that in the mammal there was some such mechanism as that which produced colour changes in the frog; *there might be nervous receptors in the skin as well as in the eye,* which were affected by light, and which influenced in some way the metabolism of the whole animal" [18].

Speaking from clinical experience in England and this country, I had been definitely convinced long before I saw this statement that digitalis has a more potent and appreciable effect here.

Photo-Dynamic Sensitization.

We now pass from a consideration of the general effects of light to that of a special action on living tissues when along with it is exhibited some sensitizing substance in quite insignificant quantity. Such substances belong generally to the class possessing the physical property of fluorescenee, though not all fluorescent substances possess this special sensitizing power.

Experiments by Hertal (confirmed by many others) show that no change occurred in bacteria in half-an-hour when exposed to light waves from near the middle of the spectrum, 518 microns, but when a fluorescent substance such as eosin is added which has its maximum absorption band in this region, the bacteria were dead in seventy—ninety seconds. The eosin had no action in itself.

"Light which has no action in itself on infusoria bacteria and blood produces the effect of ultra-violet light when certain dyestuffs are present." Ultra-violet light of 280 microns killed the bacteria in sixty seconds. Light of 448 microns in which eosin has nc absorption band had no effect on them with the presence of eosin or without. [19].

(The visible spectrum ends at about 400 microns.)

A certain sensitizing substance, or rather a group of such, all related, with widely varying results, has been discovered in the human organism, in the urine and blood, viz., hæmatoporphyrin, but before referring in detail to the available knowledge on this I should like to mention some clinical points about sensitization.

Herpes Labialis *vel* Malariæ.

In malaria there is, especially in the autumn months, when it and blackwater are most rife, a pathognomonic herpetic eruption round the mouth, most generally affecting the upper lip. A layman seeing this on a friend remarks: "You've had fever?" They are commonly known as "fever blisters." It has occurred to me that this might indicate a sensitization to light. A similar eruption occurs in other fevers, though not so marked and constant as in malaria, but in these also some pathologic sensitizing product may be present.

"With the possible exception of pneumonia, herpes is seen more frequently in malaria than in any other disease. Its commonest sites are the lips and nose, but it may appear elsewhere. It is not nearly so common in the negro as in the white. Urticaria and erythema are sometimes observed" [20].

Barber, discussing protein sensitization in its relation to certain skin diseases, remarks: "Herpes catarrhalis is of course a frequent symptom of the common cold, pneumonia and cerebro-spinal meningitis, but may in certain people invariably result from the eating of a certain article of food such as cheese" [21].

Earlier in the same paper Barber quotes McBride and Schorer (*Arch. of Med.*) in a paper on "Erythematous and urticarial eruptions resulting from sensitization to certain foods," who "Make the

interesting observation that animal intestinal parasites are capable of rendering certain foods toxic—for instance, eggs—and that destruction of the parasites may produce immunity to the foods in question." This forms a good example of the oak and mistletoe simile. The protein sensitization explanation of the nature of certain skin eruptions, including some forms of eczema, is accepted, no other factor being called into account, but mark the following: "It is difficult to explain susceptibility towards non-protein drugs such as quinine or towards external irritants on the grounds of anaphylactic sensitization, and yet the accompanying phenomena are often so similar as to suggest that they are closely related" [21].

I have seen the most violent urticaria follow the taking of quinine by mouth. It did not occur on intra-muscular injection. A personal experience I have had in common with many others, and one which we do not repeat, is that on taking five grains about 10 a.m. and exposing oneself to the sun afterwards one quickly becomes groggy in the legs, giddy and may almost collapse. The standard prophylactic is "five grains of quinine *at night*."

The discussion on "cutaneous sensitization" at the 1921 [22] annual meeting opened by Cranston Low ended on the note of the importance of light, and this was before heliotherapy was so widely discussed as it is to-day.

Kenneth Wills mentioned an erythema of old people "in which there was another factor besides cutaneous sensitization—namely, light." Barber agreed with him that light was an important factor in the determination of lupus erythematosus, and described another type in which sensitization came on in adult life: "In all the patients there was marked excess of indican in the urine and in most of them the reaction was intense." He had never found hæmatoporphyrin. Low in reply quoted an article in which was described "fago pyrismus," or buckwheat poisoning. "Animals fed on buckwheat and exposed to light developed acute dermatitis on white parts only, not on black. In buckwheat there was a substance which very closely resembled hæmatoporphyrin."

(To be continued.)

On the Human Liver-Fluke in Korea and a note on the Immediate Hosts of Liver-Fluke in China (Harujiro Kobayashi, *Mitt. der medizinischen Hockschure zu Keijo*, 1924).—In Korea human liver-fluke is a common disease, especially in the southern part of the peninsula. *Lutreola sibiricus* was found to to be a natural host of *Clonorchis sinensis*. The first intermediate host of *C. sinensis*, *Bulimu striatulus japonicus*, is present in various parts of Korea, where liver-fluke disease exists. Several species of cyprinoid fishes in Korea were found to be infested by the encysted larvæ of *C. sinensis*, also a number of fishes of China. Human liver-flukes in Korea are of one species, i.e., *C. sinensis*, as is the case in Japan proper.

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A WHITE AUSTRALIA: IS IT A POSSIBILITY?

By SYDNEY J. SKERTCHLEY, J.P.

(*Continued from page* 32.)

CHAPTER VII.

The Anthropology of the Roman Empire.

96. We stated in the last article that the Roman Empire was practically confined to the area in which the Dark Whites were indigenous, and that

while the Dark Whites were incapable of establishing themselves in the home of the Fair Whites, those more vigorous people conquered, and for centuries held the whole of Europe, and the greater part of Roman Africa. Lastly, that over the whole of this great area the Fair Whites either completely died out, or are being steadily replaced by the native Dark Whites. These are such momentous statements and have been so overlooked by historians and politicians, that it will be wise to make the matter perfectly clear.

97. Take the first point. Look at the extent of the Roman Empire as it existed at the beginning of our era. The Eastern dominions in Asia do not concern our immediate object, but they tell the same story, for the Romans never established themselves in the region of the Yellow Race.

98. The northern boundary of the Roman Empire is a line drawn from the Roman wall in Britain south-east to the Rhine, thence down that river to the upper Danube, which stream it follows for a while, and then makes a wide detour northward, so as to embrace the area between the rivers Theiss and Dneister, and the Carpathian Mountains, a compact area now forming part of Hungary, and all of Roumania. This was the portion which became the province of Dacia, and was only held for 164 years, from A.D. 106 to 267. This shows the greatest extent of the Roman sway in Europe.

99. In some respects the Roman Empire was held together much as we now hold India, by force of arms, by the administration of strict and sympathetic justice, and the maintenance of civil rights including above all the rights of property. The parallel must not be strained, for the Roman Empire was an undivided area that had been accreted around Rome, and was in consequence much easier to administer than the scattered dominions of King Edward.

100. Now consider the nature of the army that sustained the power. At its greatest strength it probably never exceeded half a million all told, a number that to-day even the populace of ancient Dacia far outnumbers.

101. It was made up of two divisions, the legions and the auxiliaries; each legion having its attached auxiliary, about equal in number. The legions were, at first, exclusively confined to Roman soldiery, not necessarily of Roman birth, but of Roman citizenship. For our purpose we will assume they were all of the Dark White race.

102. The auxiliaries, on the other hand, were all foreigners, and though many were of the Dark Race the majority were selected from the more hardy and vigorous Fair Whites of the strenuous north. We are expressly told they were preferred, and moreover, some of them were infused into the legions themselves. Mark this difference. We stiffen our Indian army with a few Fair Whites, so did the Romans; but in our case it is the conqueror that stiffens, with the Romans it was the vanquished.

103. The Fair Whites of the Roman army were at first pressed men, soon they became mercenaries, and finally masters. It is hard for those who are unacquainted with the story of the Roman Empire to realize how much it owed its power to the Fair Whites. Not only did they supply troops, but leaders, alike in the field and the Senate, and if they did not actually give a Cæsar to the Empire it was because they preferred not to adopt a title derived from a Roman family, and became kings in their own right.

104. We are apt, too, to overestimate the size of the Empire. We mentally measure it by the magnitude of its deeds, and the supreme value of its civilizing powers. In point of geographical fact, at its widest span it was little more than half the size of Australia—say as large as Queensland and West Australia combined. It was held by forty-six legions, and how powerful were the Fair Whites upon its frontiers is proved by the necessity of maintaining half this number on the Rhine-Danube border.

105. Look again at the map. A very startling fact comes out. The Romans never got anywhere near the motherland of the Fair Whites. It was always the Fair Whites who in their southerly advance fell upon the northern frontier of the Empire. They rolled Rome back; Rome never infringed an inch on the Fair White soil.

106. So powerful did the Fair Whites become, that by about the end of the fifth century all Europe was in their hands, save Greece. The old Roman Empire was no more. Odoacer the Ostrogoth was King of Italy, and the Eastern Empire was Roman only in name, and was hastening to decay.

107. I have shown the areas ruled by the Fair Whites and Dark Whites. It will be seen that the latter have lost everything, save in the extreme south-east. Even North Africa is under a Fair White king. Surely, never in the world's history has there been such a complete overmastering of one race by another—the Dark White has practically gone under. The Fair White kingdoms on foreign soil are the Anglo-Saxons, the Ripuarian and Salian Franks, the Visigoths and Ostrogoths, the Suevi, the Vandals, the Burgundians, the Lombards, and the Gepidæ. Not a single one has lasted; their names are but shadows and over the greater part of the area the blood has faded as completely as the fame.

108. The conclusion is incontrovertible. *The Fair Whites have never been conquered on their own soil (save by themselves); they have been conquerors everywhere else, but have gone down surely and steadily before those ethnic laws which seem to have set a bound to race extension.* "Stat nominis umbra" may be written over half Europe.

Spain and Portugal.

109. The darkness of the Dark Ages fades into twilight at either end, but we shall not be far wrong if we make it begin with the fall of the Roman Empire, A.D. 476, and end with the fall of the Eastern Empire in 1453. Henry of Portugal, surnamed the Navigator, son (let us always remem-

ber) of Queen Philippa, daughter of old John o' Gaunt, had fixed his observatory at Sagres, the westernmost point of the continent, where the deep waters of the Atlantic allow the Australian liners to pass close in and view the fine cliffs of St. Vincent of naval fame. The fall of Rome had caused the closing of learning to Europe, and now half a millennium had passed, and Constantinople—the new Rome—has fallen, too, and has let the flood of learning loose upon the darkness of monkish superstition. Henry has sent his trader-discoverers along the African coasts, the Cape of Good Hope is found, and Columbus is back again with a New World as his reward, and all in the space of a few years. From this epoch modern geography dates. The Dark Whites were to have a fresh trial, but this time their conquests were to be in far lands —it was the era of maritime discovery.

110. This history is so close to us as to need no epitome. But what have been the results; has the darker race been more successful in the warmer regions more akin to his own than in the chill north? Let us take the case of Spain first. Everybody knows the story of Cortez and Pizarro, and the band of Conquistadores who made Spain rich and glorious, who poured the riches of a virgin continent into the coffers of Castille. Let us seek their descendants.

111. Come to California, whose splendid capital, San Francisco, looks out, across Saucalito, through the Golden Gate into the Pacific, first gazed upon by Bilbao. Where is Spain? Fifty years ago, when Dana wrote his famous "Two Years Before the Mast" it was still Spanish, but the Spaniard was a wreck, and the country going fast to decay. Dana scraped hides on the bare ground where now million-dollar buildings stand. In three hundred years the Spaniard had done nothing but build a few missions, and lead the lazy life of a rancher. Thirty years ago I sought in vain to find a Spaniard or a real relic of his presence. I found a fragment of an adobe wall (Indian, not Spanish) where the Mission Dolores preserves its old name, and this was all.

112. Try Mexico. Listen to what my friend, Dr. E. B. Tylor wrote in 1857 or thereabouts. Do not miss the point that the Spaniard never discovered the mineral wealth of California; neither did he in Mexico. The Aztecs had done that for him. So here, with wealth ready to hand, the Spaniard built, or altered to his taste, fine cities, and impressed his language upon the people; and here he is to-day.

113. After illustrating the deplorable state of the Government, he proceeds: "The Indians have been of late years becoming aware that the government of the country is quite rotten and powerless, and that in their own districts at least, the power is very much in their own hands, for the very few scattered whites could offer but slight resistance. The doctrine of 'America for the Americans' is rapidly spreading among them." The learned anthropologist predicted that sooner or later the Spanish rule must cease, and though he saw the difficulties in the way, he thought the United States would be compelled to come on the scene.

114. What has happened is curiously instructive. Mexico is still an autonomous republic, but since the stoppage of a regular supply of fresh blood from Spain, consequent upon their separation in 1824, the Spanish blood has been dying out, and the Indian gathering strength till now it is not the Spaniard but the native who is the real power, and the owner of the principal wealth.

115. The tropical republics, as all know, are a by-word; Venezuela has made herself notorious of late by the culmination of a long innings of rascality. In the West Indies, Spain to-day holds nothing. Of Spanish South America I can say nothing from personal knowledge, but if one takes the summary of my friend, Prof. G. G. Chisholm, the eminent geographor, and president of the Geographical Section of the British Association, it will be seen that, at any rate in South America, the Dark Whites have not peopled, though they may hold the territory. He writes: "The enervating effect of the climate in the tropical portion of the continent has retarded the development of the immense resources of the land, notwithstanding the facilities presented by the navigable streams; and it is believed by some that Chinese labour alone can bring wealth and prosperity to these burning lands. In spite of the fact that the land has been so long in the hands of Europeans, it is said that there are not, in all South America, at the present day, 100 miles of what Europeans would call roads."

116. Now the area of South America is about double that of Europe, or say four times that of Australia, yet the total population is only thirty-four millions, or one-eleventh that of Europe. Of these, only about 680,000 are whites, chiefly Spanish and Portuguese.

117. As South America was colonized before North America, and has been under European control for over four hundred years, and has produced colossal wealth for the stranger, and yet has not been able to produce a white population much larger than that of Queensland, it is quite clear that in this new world even the Dark Whites have not been acclimatized. We must also remember that much of the most populous parts, along the Andes, enjoy a temperate climate, in spite of their geographical position. Further, we must bear in mind that the great wealth has been won largely by the enterprise of the Fair Whites, who are only temporary sojourners, and that most of the Dark Whites who have shown commercial energy have been direct immigrants from Spain and Portugal, not descendants of the conquerors.

118. Let us now turn to the Old World, of which I can speak from long personal experience. One of the oldest European settlements in the Far East is the holy city of Macao. Founded in 1557, it soon had a Portuguese population of over 20,000, and was dignified by the title of Cidade do Santo Nome de Deos en China, City of the Holy Name of God in China. Here their great poet, Camoens, wrote his classic epic, the Lusiad. It is now one

of the saddest places on earth, at least to those who ponder over the great things Portugal did for the Far East. The cathedral, burned in 1835, is a ruin, typical of the people. The beautiful language has degraded into a clipped patois; the Macaoese, less than 9,000 in number, are undersized, ill-nourished, and of a low intellectual grade, retaining nothing of their famous nationality but their pride and noble names. They half starve themselves to make a brave show on the side-walk: live by competing with the Chinese for poor clerkships in Hong-Kong, where they never rise, and are mistrusted; and its once famous city depends upon its gambling houses, drawing clients from outside, for the Macaoese are too poor to be of financial support, sportsmen though they be. They are stunted in growth, and often deformed, so that if you meet a well-grown man the chances are he has come direct from Portugal.

119. If you visit Timor things are worse still. The native Portuguese count for nothing, and the imported Governor and officials go in daily fear of their lives. But that I have received much courtesy from them I could draw a painfully true picture, showing that Portugal has been a dismal failure in these beautiful lands. Goa, their Indian capital, is moribund, and no one who has experience of Portuguese Africa retains much respect for the remnants, degraded in blood and physique, of the nation that did more to establish trade, to put down piracy and to infuse civilization, than all the Spanish and Dutch that ploughed these then unknown seas.

120. So, too, with the Spanish possessions. The Philippines take their name from Philip II of Spain, the author of the Spanish Armada, and his people no more conquered the Philippines than his ships conquered England. This great archipelago, stretching across fifteen degrees of latitude, and embracing 115,000 square miles, never became Spanish in the same sense that Chili and Peru have done. You can stand in Manila and see regions that the Spaniard never ventured into, whose natives never acknowledged them, never paid them voluntary tribute. On many islands —Palawan, for instance—no Spaniard dared live. I have been in Sulu when the capital, Tiangi, has been besieged by a handful of natives, and not a nose of the garrison dared show outside the city walls. And I have seen blockhouses—as in Siassi —where the guard was only permitted to re-enter the town on sufferance. To those who know not the state of matters in these rich islands it will come as a surprise to hear that Manila, with its 300,000 inhabitants, was never a Spanish city. It is a great city with a small European quarter, just as Shanghai or Tientsin are. The Spaniard ruled but did not occupy and Manila never contained 10,000 Europeans all told. The Americans made the mistake of thinking that when they beat the Spaniards they had taken the Philippines. They had learned better now, and they at least are sure that in three centuries the Spaniard had not thriven in the islands of the Orient.

121. This is sufficient evidence for our purpose. The Portuguese made a deeper impression on the Indies than the Spaniards, but neither succeeded in establishing his race. It is one thing to occupy a land by force of arms, and by wise administration, but it is quite another thing to populate it as colonists, and by natural increase. Even where Portuguese and Spanish blood has survived, as in Macao and Luzon, it has been by the infusion of native blood, and the people are half-castes, the Mestizo population of the Philippines far outnumbers the folk of true stock, even when the recent immigrants from Europe are taken into account.

The Dutch Indies.

122. The Dutch have been more successful in the East than the Spaniards or Portuguese. Java is rich and flourishing. And the Dutch belong to the Fair Whites. Moreover, they convinced Alfred Russell Wallace that the tropics could be successfully colonized. His opinion, expressed in his classic work on the Malay Archipelago—after all these years the best work on the subject—is quoted daily in support of the feasibility of the white man making for himself a new home in the gardens of the sun. I believe he has seen reason to modify his opinion, but how far I am not in a position to say.

123. Now I know the whole of the region he so splendidly describes and have spent as long in wandering over it, and have come to quite a different opinion from that usually attributed to our veteran naturalist. I fear he has been misunderstood. In conversation, it always seemed to me that Wallace never said the white man had actually succeeded in establishing himself in the tropics, but that, with proper care, he might do so. The two things are not on a par. I consider both equally erroneous. His latest pronouncement, in 1898, was that it is " because white men, as a rule, do not work enough in the open air in the tropics that they suffer in health," and he points out that the women of the ruling class suffer most, for they take least exercise.

124. M. de Quatrefages, the veteran French anthropologist, also is firmly of opinion that white men can thrive in the tropics, and while admitting (as indeed all must do) that exercise in the open air is necessary for the preservation of health (he might have included the temperate and arctic regions), yet he looks upon the high death rate as directly due to two causes, first to tropical disease, chiefly malaria, and secondly and chiefly to lack of acclimatization. Destroy malaria, he adds, and man can live in the tropics healthily, when he has become acclimatized. He proceeds to show that ten generations, say 250 years, are not more than half enough to become acclimatized, and so accounts for the death rate in French tropical colonies.

125. To this we reply that no sort of man can thrive in any kind of climate if it is unhealthy, and that if it takes five centuries to get inured to a new climate, one might as well throw up the sponge at once.

126. Dr. J. W. Gregory has an interesting chapter on the "White Australia" policy in his recent volume on "Australia" (1906), and says deliberately "there is nothing in the heat of any climate in the world which is necessarily fatal to European races." He looks to hygienic improvement in the rearing of children, as sufficient, and makes the (to me) amazing statement that "Anglo-Indian children are now sent home for education as much as for health." This begs the whole question, but let that pass. Admit that children can be successfully reared in India—and I have known many—still their physique is impaired, and they are almost invariably sterile. At any rate, no one has yet produced a single specimenn of a third generation of English-raised man or womanhood.

127. Another weighty advocate, but a fair one, in favour of a white tropical race, is the Hon. H. Demarest Lloyd, an American writer on social subjects whose work "Newest England" (New York, 1900), all Australians should read. I talked the subject over with him many times, and he has fairly stated my views. But he has no personal experience of the tropics, and only gives the views of others. As an American he is anxious as to the future of the Philippines and Sandwich Islands, to say nothing of Cuba, and perhaps his desire may have influenced his judgment. Till he can find at least one case where a white race has maintained itself in the tropics without constant recruiting from home, I must continue to affirm that opinion, unsupported by historical evidence, is of no value whatever, no matter how great may be the authority quoted. And this brings us to the critical test of the Dutch Indies.

128. The prevalent idea about a Hollander is that he is Dutch built, so to speak; bluff bowed, and slow as a galliot. This is a cruel libel. I have known him in Holland and in the tropics, and he is more like an Englishman than any European except a Dane. And in the tropics he leads a wiser style of life than most Englishmen. He dresses sensibly, takes his siesta during the noonday heat, closing his office so that none of our foolhardy countrymen may tempt him into sunstroke, and where he can, as in Java and Sumatra, sleeps in the cool air of the hills, instead of stewing on the coast. He has made a success of some of his tropical colonies, and I admire and respect him for it. But I blankly deny that he has solved the problem, and learned how to euchre the climate for his own and his children's benefit. The only test is a statistical one—has he increased in numbers without recuperation from Holland? His own population tables shall answer.

129. Java is their most flourishing possession, and it contains a total population of nearly 20,000,000, of whom only 30,000 are Dutch. In the years 1868-78 the increase of all Europeans was only 1,532, and between 1869 and 1877 there was an actual decrease in numbers. And this includes not only the Dutch who claim to be native, but those from the old country and other parts of Europe. This means that without immigration the Dutch element would die out, since it only remains stationary by the aid of the newcomers. The Chinese, who number 200,000, have increased 33,000 in the same period. That is, their increase alone is more than the whole of the Dutch population. The native population, nearly 19,000,000, has in the same period increased nearly 5,000,000, and there is no immigration to be taken into consideration in their case.

130. It is perfectly futile to say that the Dutch would have increased faster had they lived more hygienically—they are the most careful of all the white people in the East. And it is only adding proof to conviction to point out that in other parts of the Dutch Indies they have not done so well. In Sumatra they have been trying all my life to subdue the Achinese. In the Moluccas and Borneo they have never got far inland. And nowhere there, or in the Celebes, has any Hollander nursed a native-born grandchild. There is no third generation.

131. Finally, let us inquire into the opinions of Dr. A. R. Wallace and Professor de Quatrefages—that if white men took to outdoor life they would be as healthy in the tropics as at home. Here I can give personal experience, for I have done strenuous out-door work in the tropics as an explorer and pioneer. I have also been interested in the opening of many estates—tobacco, sugar, and all sorts of tropical products—and I have been intimate with many planters, Dutch and others, who have been sons of planters, and who knew every wrinkle experience could teach, and this not for a year or two but for many years. I claim to be able to speak with authority, and I affirm that it is impossible for a white man, dark or fair, to work continuously in the tropics, especially in agricultural pursuits, without becoming a physical wreck, unless he has pretty frequent change to some bracing climate. No white man could possibly work continuously as a plantation labourer. Even the Asiatic coolies cannot stand it for many years. So exhausting is the work that I have sometimes thought, as I watched the graveyards grow in extent, whether the produce was worth the sacrifice in life and disease.

The white managers and overseers suffer only in a lesser degree owing to their work not being so physically exhausting. Three years is as long as they can endure at a stretch—then a year at home braces them for another course of steady deterioration of health. Mail by mail I have met new hands from Europe full of the untasted glamour of the East, full of home-taught lessons about the necessity of avoiding the pernicious ways of life of the old hands. They came, a steady stream, and lectured us old stagers on our evil ways, and forthwith started in to set us laudable examples. We smiled the smile of callous experience; we had all been in the same boat. Every single soul of us had come out as a shining example, as a missionary of the new idea—we bided our time. Then they came back to us; not one here and there, but ninety-eight out of every hundred, with the fear of death

upon them, and we nursed them back into new life, or buried them. Those who survived were no longer griffins, and they met the next griffin with the silent grin which signifieth " you'd better bide a wee." I have stood by too many graves, have helped too many broken constitutions down to wharf, to speak lightly on this matter. Pride, and the spell of the East, which grips all us old hands, causes us not to brag of what we have gone through; familiarity of the precariousness of life has made us indifferent perhaps, but none of us is deluded for one moment by the theoretical dicta of philosophers whose language concerning things they know of is as tropic as their homes are temperate. *The white man can and will rule in the tropics, but he will never colonise it, never develop it with the work of his hands.*

132. But the great and honoured Frenchman, de Quatrefages, thinks his countrymen can people the lands of the burning sun. It is a fond desire, and methinks his wish marches ahead of his judgment, or perchance he fails to read the dry detail of his own colonial budget, otherwise he would know that in the French possessions of the Far East the officials pretty nigh equal the unofficials, so little more than a dream is their occupancy. But he would doubtless reply, they have not had time to become acclimatized. So let us take his own illustration of what a Frenchman can do where the sunshine is stronger, though not brighter, than in his own fair land of France.

133. Speaking of Bourbon, he says, " The Whites of Bourbon form, in reality, two classes, or rather two races, distinct in their manners and customs. The former includes the population of towns and large settlements, who lead the ordinary life of colonists, and especially avoid agricultural labour, considered by Creoles as degrading as well as fatal. The latter includes the " Mean Whites," descendants of the original colonists, who, too poor to buy slaves, were forced to cultivate the land with their own hands.

134. Now, of these two classes of colonists, it is the former alone which supply the mortality to which attention is so often drawn. The " Mean Whites " live as their fathers lived; they inhabit and cultivate the less fertile districts of the island. Far from having deteriorated, their race has improved, and the women, in particular, are remarkable for beauty of form and feature. The race maintains itself perfectly, and seems to be on the increase. Crossing, moreover, has no influence in the matter, for the " Mean White," proud of the purity of blood which constitutes his nobility, will not, at any price, ally himself with the negro or coolie.

135. " Thus at Bourbon, indolence, and the habits which it involves, destroy the rich and those who try to imitate them, while the poor become acclimatized through sobriety, purity of manners, and a moderate amount of work. From the latter, anthropologists and all the world may learn a lesson of grave importance, at once scientific and moral."

136. Truly, all men may learn a scientific and moral lesson from this statement of facts. Stripped of its Gallic glamour it proclaims aloud that the only Frenchmen who can live in Bourbon are the " Mean Whites," poverty-stricken and intellectually incapable of rising, so that they are exiled into the least fertile parts of the country. I will not comment upon this, save to suggest that the promise of such a fate would be but a poor allurement for an intending emigrant.

137. In my next I will come closer home and inquire whether the Fair White is holding his own in the United States; whether the Monroe doctrine is a prophetic vision or an intangible dream.

Annotations.

The Possible Incidence of River Fever (Tsutsugamushi Disease) in the Central Yangtze Valley (E. Carrol Faust, *The China Medical Journal*, December, 1923).—Two cases from the Wuhan area, with a primary diagnosis of schistosomiasis japonica, but having in blood and spleen smears micro-organisms resembling stage for stage the micro-organisms described for Japanese river fever, and exhibiting certain typical symptoms of this disease, are given that tentative diagnosis. The presence in China of many cases of splenomegaly with obscure etiology, together with the account of the presence of this infection in China in ancient times, makes it advisable to keep this point in mind in studying such cases, and to determine the distribution of trombidæ in such areas.

Mitral Stenosis without Rheumatic Fever in North China (H. E. Meleney and Irmarita Kellers, *Arch. Internal Med.*, October 15, 1924).—Mitral stenosis is the most common valvular disease of the heart in Peking, although rheumatic fever is very rarely seen. Thirty-nine cases from the medical clinic of the Peking Union Medical College Hospital are reviewed. In the histories of these patients only one case of rheumatic fever, one case of chorea and fourteen cases of " joint pains " occurred. No other infectious diseases appear to be especially involved in these cases of mitral stenosis. In sex and age incidence, in electrocardiographic phenomena and in the pathology of three cases which came to necropsy, these cases are similar to the cases of mitral stenosis of rheumatic origin seen in Europe and America.

Pseudo-Malarial Attacks in Typhoid Fever (G. Caussade and H. Le Rasle, *Presse Med.*, September 13, 1924).—Six cases are recorded of the pseudo-malarial type of fever, first described by Jaccaud, 1884, which occurs during defervescence or at the beginning of convalescence from typhoid. The attacks may be of short, moderate or long duration, and are generally daily, but, in rare instances, are bi-quotidian or tertian. The end of an attack is marked by swelling and a fall of temperature.

Polyuria often occurs at the end of an attack, and is sometimes as much as five pints in twenty-four hours for several days. The patient generally recovers. Cholecystitis, pyelonephritis and a relapse of malaria must be excluded in the diagnosis. Quinine will have a successful effect on the attack if malaria is present, this being ascertained by finding the malarial parasite in the blood.

The Treatment of Leprosy in Ceylon (R. Pestonjee and L. Nicholls and J. E. Felix, *Ceylon Journal of Science*, vol. i, part i, June 4, 1924).—From the experience of these authors at the Ceylon Asylum for Lepers, it is seen that none of the many drugs brought forward with a claim to curative value in the treament of leprosy is of any real value in this disease; some there are that cause an improvement in the patient, but even these are not sufficient. It is stated that the recovery of the majority of the patients in leper asylums cannot be expected from the use of any specific remedy because of the damage to the tissues already caused by the disease. The treatment by injections which must be continued for several years is very tedious for the patient. And even if the patient shows marked improvement no definite decision is possible as to whether or not he continues to be a source of infection to others. If the number of lepers in the British Empire diminishes considerably during the next thirty years, it will be due to general progress or to future discoveries, and not to any drugs which have been used up to the present in the treatment of the patients.

The Wadi Halfa Quarantine (Major B. H. H Spence, *Journal Royal Army Medical Corps*).—The Government of the Anglo-Egyptian Sudan, faced with the necessity of importing 15,000 labourers from Southern Egypt in the winter of 1920-1921, decided to have them all inspected, loused, vaccinated and examined and treated for parasitic worm infestation, with a view both to improving their value as labourers, and to protecting the country against the introduction of bacterial, protozoal and metazoal diseases. The existing quarantine at Wadi Halfa was adapted for the ends in view. With a staff consisting of one medical officer, one laboratory assistant, and thirty locally enlisted Berberines, the labourers were inspected, loused, vaccinated and examined and treated for parasitic worm infestation at the rate of 250 a day. 100 per cent. of 14,077 labourers from Southern Egypt were found to be lousy. All men had their heads cropped and their bodies shaved. No case of louse-borne disease occurred amongst these men throughout the season, whereas 2,000 Yemenis admitted at Port Sudan without proper precautions suffered severely from an outbreak of relapsing fever. Five per cent. of 14,077 were found to be anæmic; 0·5 per cent were so anæmic that it was considered advisable to send them back to Egypt. In the absence of parasitic worm infestation, heavy infestation with lice was the only obvious cause of anæmia in certain cases. Forty per cent. of 14,077 were found to harbour from one to four kinds of parasitic worms, 20 per cent. had ankylostomiasis. Four grammes of thymol appeared to be more efficacious than three cubic centimetres of chenopodium oil in the treatment of parasitic worm infestations amongst Egyptians. In no case were more than 200 ankylostomes recovered from a man, a result in keeping with the general appearance of the infested men. Many thousands of male and female ankylostomes were examined. All proved to be *Ankylostoma duodenale*.

8·5 per cent. of the picked labourers were found to be suffering from urinary schistosomiasis; 0·7 per cent. had to be sent back to Egypt on account of the severity of their disease. 20 per cent. of these labourers suffered from nervous retention of urine when called upon to micturate during medical inspection. These men were catheterized, and in 3,000 so dealt with only one stricture was encountered. The Government of the Anglo-Egyptian Sudan, convinced of the value of the results achieved in the first year, spent £7,000 on the erection of permanent buildings, which were completed in 1921, and have proved extremely useful ever since.

Investigations upon Flagellate Infections (R. P. Strong, *The American Journal of Tropical Medicine*, vol. iv, No. 4, July, 1924).—In studying certain infectious diseases of plants and in searching for animal parasites in the latex of various tropical plants in Central and South America, a flagellate parasite was discovered in three species of Euphorbiæ. This flagellate is of the leptomonas type and is not dissimilar in appearance to the flagellate stage of *Leishmania tropica*, giving rise to a form of tropical ulceration of the skin. In one district in Panama a very extensive phytodemic of the infection in *Euphorbiæ* was found to exist. These plants were very abundant in this region and almost every one was found infected. The infected plants showed pathological changes, and the latex of the plants was also distinctly altered, the flagellates causing disturbances in the latex of the plants, sometimes forming emboli in the lactiferous channels. The nutrition of the plant was thereby distinctly disturbed and many of the plants became atrophied.

The insect *Chariesterus cuspidatus* transmitting the infection from the plant to a species of lizard *Cnemidophorus lemniscatus* was also discovered. From extensive experiments upon animals it was demonstrated that the flagellate as it occurs in the plant, and also in the intestinal tract of the insect, is not pathogenic for vertebrates. However, after the flagellate has passed through the insect to the lizard it acquires pathogenic properties and may give rise to a form of tropical ulceration in the skin, as was demonstrated from experiments in the monkey. In this ulceration

the leishmania form of the parasite and not the flagellate stage is encountered. There is perhaps nothing very extraordinary in the idea that a flagellate found producing a disease in plants may, after passing through an invertebrate and a vertebrate host, acquire pathogenic properties for a mammal. This, apparently, is the first instance of this nature in which such a chain of infections has been demonstrated.

Myeloid Leukæmia of the Skin (J. L. Tenenbaum, *Arch. of Dermatology and Syphilology*, vol. 10, No. 5, November, 1924).—Two cases are reported of this infection. The two conditions thought of as a possible diagnosis were (*a*) malignant metastasis of the skin, and (*b*) idiopathic multiple hemorrhagic sarcoma of Kaposi. On further analysis both were discarded as lacking the essential diagnostic features. The diagnosis of myeloid leukemia of the skin was finally adopted on the following grounds. The rather sudden development of bluish tumours and nodules, scattered mostly on the trunk and extremities, which presented a globular appearance, were firm to the touch, showed no tendency to ulceration, and were practically painless, with no history of malignancy in the internal organs. The hemorrhagic diathesis of the skin including the mucous membrane, in a well nourished person who was not conscious of any grave constitutional disturbance. The glandular enlargement in the groin, which was painless, not adherent to the skin, more or less discrete with no signs of ulceration. The enlargement of the liver and spleen with symptoms of pain in the latter, which in all probability were due to perisplenitis and splenic anfarcts; and the atypical blood picture with the appearance of unripe myelogenous elements. The relatively low white blood count classifies the case as a sub-leukemic stage of myelogenous leukemia. The results of the biopsy were rather inclusive for a typical myeloid leukæmia.

Interactions of Protoplasmic Masses in Relation to the Study of Heredity and Environment in *Arcella polypora* (Bruce D. Reynolds, *Biological Bulletin*, No. 2, February, 1924).—It has been shown that, like difflugia, *Arcella polypora* will under favourable conditions, reappropriate its detached protoplasm by fusion. *A. polypora* is not attracted by a pseudopodial fragment of difflugia. If accidental contact is made the fragment is treated as a mechanical obstruction. Fusion will take place between one individual and a protoplasmic fragment of a closely related specimen. Two distantly related individuals, which have not been kept in the same receptacle, will be attracted by each other's severed pseudopods, but upon making contact the involved protoplasms will be shattered into bead-like masses. When two lines of a clone are kept under similar environments, cross-fusions between them cease after approximately twenty-two days; while if the two diverging lines are subjected to different environments, the time required for cross-fusions to cease is greatly shortened (varying from 6 to 16·5 days, depending on the factor employed). When small quantities of culture media are frequently exchanged between the concavities in which members of two diverging lines are confined, cross-fusions between them apparently continue indefinitely. After two related specimens have become negative to each other's protoplasm, cross-fusion between their progeny may be induced by (a) exchanging small quantities of culture media between the receptacles in which they are kept, or (b) by placing both of them in the same concavity. Morphological differences are not necessarily associated with different physiological states. Physiological changes do not occur among descendants of a single *A. polypora* reproducing vegetatively, but such differences are probably due to environmental influences rather than to hereditary variations.

Current Literature.

BULLETIN DE LA SOCIETE DE PATHOLOGIE EXOTIQUE. November 12, 1924.

Sleeping Sickness in Equatorial French Africa (J. Vassal).—In this paper the results of investigations in the colonies of Central Congo, Oubangui-Chari, Tchad and the Gaboon, are given. Sleeping sickness is localized along the rivers. Some places are more infested than others, such as Bouca, Marali, Crompel and Grimari, &c. Among the numerous places still free from sleeping sickness are Batangafo, Kabo, Bossangoa Katouma and others. Tchad is partially contaminated in the south. In the north it is naturally protected by the sands and a climate which excludes the tsetse, In the Gaboon districts the malady is very unequally distributed. The tsetse fly is to be found everywhere, but in diverse numbers. Mosquitoes are rare. Infantile mortality is considerable in all parts. The people are poorly nourished and their conditions of living are unhygienic.

Second Algerian Case of Mycetoma of the Foot (type Madura Foot) *due to Aleurisma apiospermum* (J. Montpellier).—The author has studied a case of mycetoma of the foot in a native of Algeria and gives the results of his mycological study. The case was one of a hyphomycete characterized by conidiaform formations, particularly adherent to the hyphæ. This is the fourth case of mycetoma due to *Aleurisma apiospermum* recorded in the literature.

On the Use of Kermes in the Treatment of Leprosy (E. Tournier).—Four cases of leprosy have been successfully treated with antimony salts—two of nervous form, one mixed, and one tuberculous. In the last two cases kermes alone was used and in the other two cases the kermes was associated with atoxyl novarsenobenzol. The amelioration of the different symptoms was very rapid, especially the nodular and mixed forms. No sign of albuminuria or gastro-intestinal intolerance was noted.

Kermes has not the strong depressive action on the nervous system and the circulation as has been observed with emetic, and can therefore be given to patients of all ages, in doses according to age of the patient.

Intermittent Inflammatory Attacks in Malaria (A. Le Dantec).—In this paper a form of malaria is described which has hitherto not been published. The patient was a Colonial of white race suffering from intermittent inflammations, affecting solely the fingers, thenar eminence, uvula, different parts of the face and the tongue. Inflammations of the tongue were particularly dreaded by the patient, which impeded respiration and the taking of food. The patient left Senegal to be treated in France. Examinations for filariæ, negative. Treated with quinine, intramuscular injections, and sulpharsenol, subcutaneous injections, the patient was completely cured. These inflammatory attacks resemble other larval manifestations of malaria, acropyrexia, urticaria, &c. The author suggests that all these syndromes should be classed under the name "sympathoses palustres."

Second Note on the Piroplasmoses of Sheep in Algeria Anaplasmosis. Anaplasma ovis, nov. sp. (F. Lestoquard).—A new piroplasma has been found in Algeria, viz.: *A. ovis*, nov. sp. *A. ovis* is transmissible to the goat. The incubation, symptomatology, the termination, the pathologic anatomy are identical in the goat and sheep. The natural disease also exists among goats, but in a lesser degree than in sheep.

Researches on Hæmaturia in Egypt (J. Khouri, of Alexandria).—During the past twenty years at Alexandria the author has examined 591 cases of hæmaturia, including 48,355 examinations of urine. The causes of hæmaturia are many and varied, but sixty per cent. of the total are cases of parasitic hæmaturia. Bilharziosis is the cause of about forty to sixty per cent. of cases at Alexandria, but further inland the percentage is higher on account of the endemic sites of infections. Fewer women are infected than men. In all cases *Schistosomum hæmatobium* has been found.

Researches on an Endemic Fever accompanied by Generalized Lymphadenitis (Toyoichi Ohtawara).—This fever was first observed in the village of Kagami (Japan) and is generally known as *Kagaminetsu*. It is a specific disease, acute, endemic, characterized by generalized lymphadenitis. After two or three weeks convalescence begins. It causes no secondary illness. The disease is more often met with in manual labourers. The pathogenic agent has not yet been discovered. Kagaminetsu is transmissible to the monkey and guinea-pig, and in the case of the monkey immunity can be acquired after complete cure of the fever. Salvarsan is efficacious in the treatment of this disease.

Note on the Mixture Emetic-Extract of Organs in the Treatment of Draconculosis (M. Peltier and H. Dominique).—Draconculosis is extremely frequent at Togo, especially where there is little rain and drinking water has not yet been provided for the natives of the country. In simple cases of guinea-worm, extraction is effected by wet dressings. In complicated cases the authors had recourse to antimony salts. Intravenous injections of emetic, however, proved more efficacious, especially in septic complications. To increase the action of emetic the process of Levaditi was tried—mixture of arsenical compositions and of antimony derivatives with fresh extract of the organs at 37°, known as trypanotoxyl, bismoxyl, &c. Stibioxyl, prepared in the same way, gave very good results in the treatment of draconculosis; the extract used was sheep's liver.

Considerations on the Connection of the Rodent Fauna with the Plague Manifestations at Dakar (M. C. Blazy).—A study has been made of the numerous species of rats found at Dakar. Examination for the plague bacillus was negative. *Xenopsylla cheopis* was found in large numbers, in one rat 124 were counted. *Sarcopsylla penetrans* was very rarely found. Inoculations of flea emulsion into mice showed the cutaneous parasites of rats to be free from plague bacilli. Reports show that murine infection coincides with human plague. Owing to disinfection of houses, and amelioration in the public service, &c., no cases have been reported since 1923.

The Sixth Case of Kala-Azar in Algeria (H Soulie).—Infantile kala-azar is very rare in Algeria hitherto five cases have been recorded; the author describes the sixth, in a boy of two and a half years. The infection was contracted at Boghni; the origin is unknown, but it is probably due to an infected dog or cat.

On the Frequence of Cutaneous Staphylococcic Infections at Tangiers (P. Remlinger).—Furunculosis, folliculitis and ecthyma in Tangiers are nearly always observed on the lower limbs, but the whole body may be affected, especially the uncovered parts, fingers, wrists, &c. The disease is nearly always multiple, appearing generally during the dry season, but can be found all the year round. Familial and house epidemics are not rare. In Tangiers, as in all other places, these diseases are seen on dirty children and adults whose profession exposes them to contact with dirt—chauffeurs, mechanics, &c. The disease is common in natives and Mussalmans; it occurs with equal frequency among the white race at Tangiers. Meteorological factors and unhygienic conditions have much to do with the frequency of staphylococcic affections in Tangiers.

Conclusive Experiments on Intradermovaccination against Bacterial Anthrax in a Severely Infected Area (H. Velu).—These experiments, carried out in Morocco when conditions were very severe, prove the efficacy of the Pasteurian vaccines; it is the same in Morocco as in France. The vaccine prepared at the Laboratory of Casablanca is as active as the Pasteurian vaccines, besides being cheaper and more practical in the colonies.

Original Communications.

THE ÆTIOLOGY OF HÆMOGLOBINURIC FEVER.

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THERE are few problems in tropical medicine which have caused more controversy than the ætiology of blackwater fever. Three theories have been advanced in explanation :

(1) That it is a symptom complex of a malarial infection.

(2) That it is caused by a specific organism which occurs in localities where malaria is prevalent.

(3) That the administration of quinine alone is responsible for precipitating an attack.

An enormous amount of literature and statistical data has accumulated on the subject. Most authorities now believe that blackwater fever is associated in some way with a malaria infection and that *Plasmodium falciparum* is chiefly, if not altogether, incriminated. If this hypothesis be correct the question naturally arises as to how hæmolysis occurs in a malaria infection. That it does not always follow an æstivo-autumnal infection, but only in a small percentage of these cases, is a self-evident fact to all practical workers in tropical climates where malaria is prevalent.

Certain facts in regard to its incidence appear to be fairly well established.

It is generally met with in malaria-infected individuals suffering from malnutrition, chronic organic disease, or some complicating infection which lowers resistance. It may develop in a few hours after unusual exposure to the hot sun, a severe chilling of the surface of the body, over-exertion, fatigue, mental excitement or depression—in fact, anything that tends, temporarily or permanently, to lower the resistance of the patient.

Again, it frequently develops after the administration of a dose of quinine.

Any satisfactory hypothesis as to its ætiology must, therefore, be sufficiently comprehensive to explain all these factors.

In 1898 Bordet discovered that defribrinated rabbit's blood when injected at intervals of a few days into the peritoneal sac of a guinea-pig did not materially influence its activity, but in the body fluids or blood plasma of the guinea-pig a substance developed which rendered the plasma or sera capable of dissolving rabbit red blood cells, which power it did not previously possess. In other words, a hæmolytic agent or property was developed by the guinea-pig specific for rabbit blood cells, but for no other animal. This hæmolysin when injected into the rabbit in small doses caused hæmolysis of some of its red cells and in larger doses a sufficient number of red cells were hæmolysed to prove fatal. If, however, small doses were injected at intervals of a few days the rabbit developed in its plasma an *antihæmolytic* agent which prevented further damage. It is further interesting to note that these newly-developed agents or immune bodies are specific in each instance for the cell or antigen involved. Moreover, the same phenomenon could be observed when other than cells were injected into an alien animal. In each instance cytolytic substances were formed specific for all the cells injected.

These observations form a basis for the consideration of the development of the hæmolytic agent of hæmoglobinuric fever.

The malaria parasite must be considered to be an animal organism. It is unicellular and undifferentiated, but has all the necessary functions of a parasitic animal. The protoplasmic cellular constituents associated with its vital functions are similar to those of higher animals. The organism is sensitive to temperature and other mechanical and chemical irritants; it eats, digests, grows, excretes, and reproduces itself—physiological properties possessed by all more highly specialized and organized multicellular organisms. If there be any difference in its protoplasmic activity we have no means — chemical or microscopical — of determining it. Fundamentally its structure and physiological activity is similar to that of more highly organized life. We have every reason, therefore, to believe that the hæmoglobin of the red cells, consumed by it during feeding, will develop hæmolytic agents in its body substance similar to those which are developed in the guinea-pig's blood, when the red cells of the rabbits are absorbed by it after injection. In other words, it can be logically inferred that each malaria parasite develops a hæmolytic property. In a malaria infection not only are red cells destroyed, but the colour index of the remaining individual red cells is lowered to a considerable degree. Is it not reasonable to believe that the resulting anæmia of a malaria-infected individual is due to this hæmolytic agent?

Furthermore, can we not correlate this action with that of the hookworm, which is a blood feeder, and which produces anæmia in the host? The small amount of blood which several hundred hookworms will destroy daily will not account for the severe anæmia observed in these cases — and it is now generally recognized that hookworms produce a hæmolytic agent, which is largely responsible for the resulting anæmia.

It would seem at first sight that very little hæmolysin could be produced by a malarial organism, but we know that in a severe malaria infection 20 per cent. or more of the red cells may be invaded by parasites. This is equivalent to about 1,000,000 parasites to the cubic millimetre and 1,000,000,000 to the cubic centimetre, 30,000,000,000 to the oz., 480,000,000,000 to the lb., and in a man weighing 150 lb. there are about 12½ pints of blood, so that there would be about 6,000,000,000,000 parasites present in a severe malarial infection. Each red blood cell has a cubic capacity of approximately 1/171,277,000,000 of a cubic in., and according to J. G. Thomson at schizogony the *P. falciparum* occupies two-thirds of this space; its cubic capacity therefore is two-thirds

of this, or 1/256,915,500,000 of a cubic in. This, multiplied by the number of parasites in a severe malaria infection, gives approximately 23·3 cubic in. of malarial protoplasmic material in a man weighing 150 lb. when 20 per cent. of his red blood cells are invaded.

We are all familiar with the anæmia and cachexia developed by a malignant tumour of similar cubic capacity. The malarial parasites also show a malignant action in their clinical symptomatology. The effect of 23·3 cubic in. of malarial material undoubtedly would be capable therefore of producing an enormous amount of hæmolysin in the human blood and, in response to its action, a large amount of antihæmolytic substance. As antihæmolysin undoubtedly is the result of the reaction of hæmolysin on the tissue cells, when a man is in good physical condition he is better able to develop antihæmolytic agents. Any of the depressing agencies which are considered as ætiological factors—chronic or acute—therefore, which interfere with the development of antihæmolytic bodies—a process more or less continuous in the presence of a malarial-infected individual—would permit extensive hæmolysis to ensue in such quantities that the liver and spleen would be unable to take care of the liberated hæmoglobin, and hæmoglobinæmia would result, followed by a hæmoglobinuria.

In paroxysmal hæmoglobinurias following the administration of quinine, which destroys the trophozoites in large numbers, we have a condition in which large quantities of hæmolysin are suddenly liberated which the antihæmolytic bodies are unable to neutralize as fast as it is produced, and there is a consequent hæmoglobinæmia which overflows in the kidneys, producing hæmoglobinuria.

If this hypothesis be true it gives a reasonable explanation as to why in the treatment of post-hæmoglobinuric fever small doses of quinine should be given first, so as not to destroy too many parasites at once, and thus precipitate another attack. This is very necessary, as observed by clinical experience.

The confirmation of this theory of the causation of hæmoglobinuria rests on the ability to demonstrate the presence of hæmolysis in the blood immediately before the development of an attack of hæmoglobinuria, as its presence in the blood previous to this would be largely neutralized by anti-hæmolysis.

In this connection, the following quotation from J. G. Thomson's comprehensive monograph on "Researches on Blackwater Fever in Southern Rhodesia" is suggestive :—

> "Successful cultures were obtained of the asexual cycle of eighteen cases of *P. falciparum*, and on five occasions in which no development took place I noted hæmolysis. There was no bacterial contamination, but it was observed that if the blood was drawn at a period corresponding to schizogony in the body hæmolysis invariably took place in the tubes. Simpson (1912), while working with malaria, also found evidence of hæmolysis during schizogony. Dr. Orpen tested several of the cultures by adding complement to the tubes after schizogony had taken place, and obtained some evidence that again a hæmolysin was present at this stage. This hæmolysis did not occur in controls. As, however, the numbers examined were very few, and chance results are apt to occur, we did not feel justified in being positive about these results.
>
> "We suggest, however, that by cultural methods and the use of careful technique and controls it may be possible to demonstrate hæmolysins present at certain stages of the asexual cycle, e.g., during complete schizogony. Miss Trutter kindly examined the blood groups of a number of blackwater fever cases, but here we were unable to state that the disease showed any preference for one of these. It is probable that a hæmolysin can be demonstrated only at certain periods of the asexual cycle. The chances of detecting it may rapidly vanish as the disease progresses. We were quite unable to detect any hæmolysin in the serum of blackwater fever at any period of the disease, but, as we have pointed out, this by no means proves that a serum hæmolysin is not present."

Confirmation of the observation of Dr. Thomson and others on the presence of hæmolysin at the time of schizogony would support the theory suggested on the ætiology of blackwater fever.

USE OF IODINE IN BERIBERI.

By H. W. Ridley, C.M.G., F.R.S.

During the twenty-three years that I was employed as Director of Gardens in Singapore, I had control of from 40 to 100 coolies at a time as gardeners. These were all, or nearly all, Javanese men, for whose health and sanitation I was mainly responsible, and whose minor ailments I treated myself. In serious or obscure cases I could send them to the hospital, but, as natives generally have, they had rather a fear of the hospital, and if sent off there frequently slipped off on the way, went to other native houses and took Chinese or other native medicine or treatment with often disastrous results. To avoid this I treated myself such ailments as I could manage, most of which indeed were mild cases, skin diseases, diarrhœa and debility, malaria, accident, boils or poisoned wounds, &c. But, in addition to these, we had pretty constantly with us in the coolie lines more or less beriberi, generally of a mild type, or perhaps, more accurately, incipient cases. No man was allowed sick leave unless he came to the office to report the sickness, if he was able to; if not one of the other coolies reported it to me, and I went at once to see him so that at the first onset of beriberi I was able to deal with it. It usually commenced with acute pain in the feet, and it was at this stage I usually was able to treat the patient. A great deal has been written on the disease, so that I only record here a few observations which I have not seen recorded before. But I will first premise that on one or more occasions, in order to confirm my diagnosis, I have asked one of the doctors from the hospital to examine my patients to definitely ascertain that the disease was really beriberi, which was then very prevalent in Singapore. He confirmed my diagnosis, stating that the cases were those of a mild form of the disease.

I observed that the disease was most prevalent in the coolie-lines in April and May, when I usually had from five to fifteen men attacked, and comparatively seldom did we get cases at any other time. Also that they were nearly all men who had come to the gardens in the previous year, or about three months

before the annual outbreak. Again, we never had a case among the women or children. One boy brought up in the lines was not attacked till he had attained the age of puberty. Most of those attacked were about 18 or 20 years of age. The cause of the disease is usually attributed to the patient having fed on polished rice only, so that it is interesting to note that all women and children, like the men, ate the same food, the boys feeding with their fathers after the age of about eight years, the smaller boys by themselves, and the women and girls on the same class of food prepared in the same way after the males have fed. The food consisted of boiled rice (town-bought), a small piece of dried fish and a few chillies; occasionally during the day they bought cakes, curry, or sweetmeats, and fruit, but the rice and dried fish was the chief and often only food.

At one time, as the disease was so persistent, I thought that perhaps it was established in the houses or on the soil beneath, so I destroyed all the houses where there had been cases and rebuilt them on fresh ground, forbidding the men to use any of the wood of the old houses (which to a small extent they disobeyed), but the disease broke out again. I found that they had not destroyed the box in which the rice was kept, and in this box, later, I found cockroaches, which at one time were believed to be carriers of the disease.

The Malay houses, being raised on piles above the ground, formed a suitable space beneath to keep chickens when fenced in by wire netting. These places often swarmed with cockroaches among the excreta of the fowls, and I forbade these places to be used for this purpose, especially after a case which occurred at Government House, some two miles away from the Gardens. Here the garden coolies had lines similar to ours, and no case of beriberi had been known to occur, until one year when there was an outbreak among the men. When I went to inspect the place on hearing of it, I found they had been keeping a large quantity of fowls beneath the houses, and there was a large mass of droppings, feathers, &c. I had it all cleared out and forbade any more keeping of fowls beneath the houses, and there was no more beriberi there from that time. In my stables two saises with their families used to live, and here for twenty years or more there had been no record of a case of beriberi until one year both men were attacked; on investigation I found that beneath the flooring, which was so built as to be difficult to remove, had accumulated an immense quantity of horse droppings and urine, which had drifted beneath the sleeping quarters at the back, and was swarming with cockroaches. The flooring was removed and the mass removed, the men were cured and no more beriberi appeared.

These facts made me very suspicious that the theory that cockroaches played some part in the propagation of the disease had some foundation. In any case I took care that no animals or accumulation of rubbish was permitted beneath the houses.

Now as to the treatment of the patients. I had heard some year or two after arriving at Singapore, from I think Mr. H. O. Forbes, who travelled formerly in the East Indies, that the Dutch were accustomed to administer iodine internally for beriberi, and I tried the same treatment with such success that we never used anything else. When a patient came complaining of his feet and had other marked signs of beriberi, I administered five drops of tincture of iodine in a tumbler of water, and if I had enough and the disease had risen up the legs, rubbed them also with iodine.

In ordinary incipient cases, three doses, one a day, completely cured the attack, and even when the disease had so far advanced that the breathing and heart action were interfered with, the patient was much relieved in a very short time, and if he would continue the treatment would recover.

One fine lad I had was attacked during my absence for some weeks, and the Eurasian left in charge thought he had only rheumatism. When I returned and saw him he was in a very bad state, breathing with difficulty. I gave him some iodine at once, and by the next day he was breathing regularly and comfortably, and the pain in the legs abated. Unfortunately he went off to a native house and tried some native treatment, and died in a day or two. I had, however, several others who were nearly or quite as ill as he was, who recovered very soon. Indeed, the only two beside the one I mentioned above who died from beriberi in the garden coolie lines, died during my absence on leave, when the official in temporary charge treated them for rheumatism. The favourite native treatment was to go down to the sea coast and sit with their legs in sea mud all day, and when they were nearly well, after the treatment with iodine, I used to let them go and do so. The Government dispensary medicine for beriberi was digitalis and strychnine. I do not think it was as satisfactory as the iodine treatment, as in some coolie lines near the Gardens I heard on one occasion they were losing eight out of ten patients, while I was losing none, but I imagine their patients did not come for treatment until too late, while I got hold of my men when the disease had only just begun.

I urged the use of tincture of iodine in beriberi frequently, but at first the local doctors appeared to disapprove of it, though occasionally iodide of potassium was used; eventually, in 1894, Dr. Hoad and Dr. Highet used it, and in even larger doses than I ventured on, and the latter reported it as very effective. I am not aware whether it now forms part of the treatment, but I do not think it was so when I left the East in 1911.

ON THE INFLUENCE OF HIGH TEMPERATURE ON THE PRESERVATION OF INSULIN.

By Prof. E. Trocello and Dr. A. Cruto.

WE were induced to carry out these researches by a certain paper published in the *Observer*, November 11, 1923, relating to the alterations of insulin in tropical climates. According to experiments of the "Pasteur Institute of Burma," it was proved that both English and American preparations, arrived in

India after six weeks from date of leaving the factory of production, did not retain more than one-fifth or less of their original hypoglycemic power; this of course practically rendered the drug useless. Whether the preparations used were in solid form or in solution was not mentioned, but in consideration of the date of the experiments it is to be presumed they were liquid.

Moreover, it is not specified in the communication whether the experiments which led to these conclusions were practised on animals or on man or on anything else; if on animals only, we might be led to suppose that the rabbits chosen had something to do with the results of the experiments. However, we thought it would be interesting to establish a control of the report on our usual laboratory rabbits, to be followed by experiments on wild rabbits or rabbits of different breeds.

A few experiments were carried out in Europe at 35° C. (95° F.) on insulin A.B. produced by the same firm, Allen and Hanbury, Ltd.,[1] but it was soon seen that the experiments should be carried out at a higher temperature.

It is well known that insulin with time loses its medicinal property, and after a few months the deterioration is already noticeable. The opinion of many experimenters on this point is unanimous. And we may also add that more than one manufacturer inherent to the preparation and preservation of the drug will agree to this. Not the last point to be considered is the state of watery solution in which the almost entire total of the preparations of different origins (English, American, French, German, &c.) is preserved.

Our comparative experiments clearly show that solid insulin shows a far greater resistance to deterioration than liquid insulin.

EXPERIMENT No. 1.

With insulin kept in an incubator at 60° for 10 hours.

Solid Insulin.

Rabbit ♂ weight 1,560 grm.
Time 9.20, injection of 2 mg. of insulin.
,, 11.30, glycemia = 0·48 per thousand.
,, 11.35, typical convulsions.

Insulin in Solution.

Rabbit ♂ weight 1,430 grm.
Time 9.15, injection of 0·3 c.c. = 2 mg. (10 units per c.c.).
,, 11.20, glycemia = 0·54 per thousand.
No convulsions.

EXPERIMENT No. 2.

With insulin kept in incubator at 85° for 10 hours.

Solid Insulin.

Rabbit ♂ weight 1,900 grm.
Time 8.55, injection of 2 mg. of insulin.
,, 10.45, glycemia = 0·50 per thousand.
,, 10·55, typical convulsions.

Insulin in Solution.

Rabbit ♂ weight 1,600 grm.
Time 8.50, injection of 0·3 c.c. (10 units per c.c.).
,, 10.50, glycemia = 0·6½ per thousand.
,, 12.10, typical convulsions.

[1] *The British Medical Journal*, January 12, 1924.

EXPERIMENT No. 3.

With insulin kept in incubator at 100° for 10 hours.

Solid Insulin.

Rabbit ♀ weight 1,530 grm.
Time 8.50, injection of 2 mg. of insulin.
,, 10.20, typical convulsions.
,, 10.35, glycemia = 0·39 per thousand.

Insulin in Solution.

Rabbit ♀ weight 1,370 grm.
Time 8.50, injection of 0·3 c.c. (10 units per c.c.).
,, 11, glycemia = 0·40 per thousand.
,, 11.10, typical convulsions.

EXPERIMENT No. 4.

With insulin kept in incubator at 100° for 24 hours.

Solid Insulin.

Rabbit ♂ weight 1,210 grm.
Time 8.50, injection of 2 mg. of insulin.
,, 10.50, glycemia = 0·52 per thousand.
,, 11.15, typical convulsions.

Insulin in Solution.

Rabbit ♂ weight 1,230 grm.
Time 8.50, injection of 0·3 c.c. (10 per c.c.).
,, 10.55, glycemia = 0·75 per thousand.
No convulsions.

EXPERIMENT No. 5.

With insulin kept in incubator at 42° for 15 days.

Solid Insulin.

Rabbit ♂ weight 1,650 grm.
Time 9, injection of 2 mg. of insulin.
,, 11, glycemia = 0·51 per thousand.
,, 11.10, typical convulsions.

Insulin in Solution.

Rabbit ♂ weight 1,760 grm.
Time 9, injection of 0·3 c.c. (10 units per c.c.).
,, 11.05, glycemia = 0 62 per thousand.
No convulsions.

EXPERIMENT No. 6.

With insulin kept in incubator at 36° for 16 days.

Solid Insulin.

Rabbit ♂ weight 1,570 grm.
Time 9.15, injection of 2 mg. of insulin.
,, 10.35, typical convulsions.
,, 10.40, glycemia = 0·48 per thousand.
,, 10.45, subcutaneous injection of 0·4 grm. of glucose.
,, 11.20, typical convulsions.
,, 11.20, subcutaneous injection of 0·4 grm. of glucose.
,, 13·00 typical convulsions; injection of glucose and food.

Insulin in Solution.

Rabbit ♂ weight 1,670 grm.
Time 9.15, injection of 0·3 c.c. (10 units per c.c.).
,, 11.10, glycemia = 0·75 per thousand.
No convulsions.

EXPERIMENT No. 7.

With insulin kept in incubator at 37° for 34 days.

Solid Insulin.

Rabbit ♀ weight 1,320 grm.
Time 9.15, injection of 2 mg. of insulin.
,, 11, typical convulsions.
,, 11.10, glycemia = 0·46 per thousand.

Insulin in Solution.

Rabbit ♀ weight 1,230 grm.
Time 9.05, injection of 0·3 c.c. (10 units per c.c.).
,, 11.05, glycemia = 0·69 per thousand.
,, 11.45, convulsions.

EXPERIMENT No. 8.

With insulin kept in incubator at 42° to 45° for 33 days.

Solid Insulin.

Rabbit ♀ weight 1,300 grm.
Time 9.30, injection of 2 mg. of insulin.
,, 10.45, typical convulsions.
,, 10.55, glycemia = 0·48 per thousaud.
,, 11, subcutaneous injection of 0·4 grm. glucose; rapid cessation of the convulsions; administration of food.
,, 14.40, convulsions.

Insulin in Solution.

Rabbit ♀ weight 1,900 grm.
Time 8.30, injection of 0·3 c.c. (10 units per c.c.).
,, 10·40, glycemia = 0·61 per thousand.
No convulsions.

N.B.—In these experiments the same preparation of insulin was used, of recent date (September, 1924). Its hypoglycemic property was previously ascertained by repeated controls as follows: two milligrams of insulin, after two hours' reduction of the glycemic compound about 0·45 per cent.; successive beginning of typical convulsions. The glycemia was, as seen in the above results, constantly determined two hours after the injection of the insulin. The animals were kept fasting before the experiment for twenty hours.

From the above experiment we may infer that the insulin used by us, kept constantly at high temperature even for a long time, maintains its hypoglycemic property integrally, or remarkably well.

The preparation kept in solid form shows itself incontestibly more resistant than insulin in liguia solution. In fact, in the experiments at 100° for twenty-four hours, and in the experiments at 42° for thirty-five days, the property of the former was in no way modified, while the latter lost about one-half of its hypoglycemic property and did not cause convulsions.

Another consideration on the resistance of the experimented insulin is the length of its duration at a high temperature. The solid preparation in this respect, in the limited time of the experiments (twenty-four hours at 100° and fifteen and thirty days at 42°), did not undergo any alterations at all. Insulin in solution form appeared to be peculiarly influenced by the time of exposure; in fact, while it resisted integrally the temperature of 100° for ten hours, it lost about one half of its hypoglycemic power, both at the temperature of 100° in twenty-four hours and at a temperature of 36° in sixteen and thirty-four days. In consequence we get the following practical corollary in relation to the preservation in tropical climates of insulin experimented with by us: *the possibility of preserving the original hypoglycemic properties even at very high temperature and for a considerable length of time.*

These experiments were carried out with "Insulin Ergon" prepared in the Instituto Nazionale Medico Farmacologico of Rome.

THE ÆTIOLOGY OF BLACKWATER FEVER.

(*Concluded from page* 92.)

By W. M. HEWETSON, M.B., D.P.H.
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HÆMATOPORPHYRINURIA.

ROOF states definitely that "hæmatoporphyrin, the iron free derivative of hæmoglobin, is the precursor of bile pigments, which become reduced in the intestine to stercobilin, and stercobilin is identical with urobilin" [23]. Garrod's collection of the available information on hæmatoporphyrinuria in his "Inborn Errors of Metabolism" [24] is extremely important. And though the original should be read in full, I must here take leave to quote it very freely. Obviously work of the highest order pertaining more to pure than applied science, questions of general metabolism are raised by the subject, questions which cannot be ignored. They cannot be ignored because "pigments of this class are present in traces normally and in larger amounts, but still traces in sufferers from many maladies and in still larger quantities cause pathologic sensitization to light." Chlorophyll and hæmoglobin absorb light readily, but this intermediate product in anything beyond the normal traces sensitizes *other* tissues to light, causing it to have a *destructive* action. Yet so little of this substance is present that in Gunther's patient it was estimated at one-thousandth of a gramme in 100 c.c. of blood serum.

Gunther's case suffered from hydroa vacciniforme, and owing to the scarring, stiffness of the joints, and atrophy of the terminal phalanges, his index fingers were eventually amputated (Garrod).

The case of Meyer-Betz is now classic. He injected three grains of hæmatoporphyrin into a vein and rendered himself hypersensitive to light. Sunlight caused giant œdema, &c., and he had to live in a cellar for months, though hæmatoporphyrin *could only be detected in his urine for the first few days.* (*Ibid.*)

It may be of advantage to first make a short *précis* of the main facts given by Garrod, as follows: The porphyrins are not one, but a group. All have the four-pyrrol ring constitution. Their spectra are very complex and characteristic. They are present in traces in normal urine fæces, bile and meconium. They are present in larger quantities, but still minute, in many maladies.

"Upon a wholly different plane are cases in which the urine has a deep red colour, like that of port wine, rich in porphyrin, *and other abnormal pigments of which as yet we know little*" (italics mine).

Gunther's classification of this latter class:

(1) Cases of acute onset associated with severe toxic symptoms, abdominal pain most common and ascending paralysis most grave.

(2) Cases due to sulphonal and trional taken over

months or years, with similar associated grave symptoms—fatal ending the rule.

(3) Congenital hæmatoporphyrinuria—acute toxic symptoms wanting but greatly exalted sensitivity of tissues to light.

(4) (?) Chronic hæmatoporphyrinuria—probable that some of these congenital.

Total number of cases of congenital to date, about twenty.

It occurs in other mammals, e.g., bovines and pigs.

Nothing characteristic in the blood picture—in some cases. Enlargement of the spleen conspicuous, in some cases anæmia.

Hæmatoporphyrin in vitro sensitizes Red Blood Corpuscles to Light of 500 Microns, causing Lysis, and *in vivo Causes Death of White Mice.*

The paragraph following is taken as printed from Garrod, p. 157, but the first italics are mine. "Some twenty years ago Tappeiner and Raab discovered that certain fluorescent pigments, of which eosin is one, induce hypersensitiveness to light in lowly organisms such as paramecium. When a solution of such a pigment is added to a culture of the organisms they are killed by exposure to sunlight, but remain unharmed in a shaded portion of the same vessel. Hausmann showed that hæmatoporphyrin, which has likewise the property of fluorescence, exercises this photo-sensitizing power, not only with paramecium and red blood corpuscles, but also when injected into higher animals such as white mice. With infusoria and red corpuscles the effect is only obtained when the pigment is exposed in contact with the organisms. Hausmann showed that when $\frac{1}{100}$ gramme (= $\frac{1}{6}$ grain) of hæmatoporphyrin was injected into a white mouse subcutaneously the animal showed no ill effect so long as it was kept in the dark, but when exposed to bright light it died within a few hours."

"Hausmann (p. 161) showed by convincing experiments that the effects observed in the injected mice are mainly due to the *invisible* [italics in original] rays in the region of 500 microns, which is the region of maximum absorption in the porphyrin spectra."

Of course *in vitro* and *in vivo* are totally different, especially for red blood corpuscles. But at any rate we know that there is this specific sensitization by hæmatoporphyrin. *In vivo* any given corpuscle can only be exposed to light for a very brief period, possibly a second or so.

Relation of Hæmatoporphyrin to the Liver.

"We have still much to learn as to the source and origin of the metabolic porphyrin," says Garrod (p. 157), "but such knowledge as we possess is consistent with the view that hæmoglobin is its parent substance and the liver the seat of its formation, and with the hypothesis that what is lacking is an enzyme which is responsible for one of the stages in the conversion of blood pigment into bile pigment." . . . "Nor do we know whether excessive hæmolysis causes increased excretion of porphyrin by a porphyrinuric, as it should do if this hypothesis be correct" (Garrod).

"Guner (p. 155) found that hæmatoporphyrin (prepared in the laboratory), when injected into a dog, did not appear in the urine, but when the animal's liver was damaged by the administration of small doses of phosphorus for a fortnight injected hæmatoporphyrin did so appear" (Garrod). Details of other experiments follow, showing that the liver is the seat of the defect.

A Prima Facie Case.

Seeing that the hæmolysis of blackwater is so great and that in any given attack there is a strongly marked tendency for relapses to occur, the non-discovery of hæmolysins in the blood is remarkable and throws weight on the suggestion of the possibility of some such sensitizing product as hæmatoporphyrin being present and the cause of the hæmolysis.

The first objection, of course, to accepting this is that no excess hæmatoporphyrin has ever been noted. I can find no record of it ever having been sought for, and as the far greater quantity of hæmoglobin gives the usual bands in the spectrum, minute quantities might be overlooked.

"Some urines (of congenital hæmatoporphyrinurics) show only two bands very like those of oxyhæmoglobin, but if albumin be absent the presence of that pigment may be excluded" (Garrod). In blackwater fever albumin is always present, hence detection of porphyrins of such a class would be extremely difficult and call for high technical ability.

"In the cases (two brothers) described by Arzt and Hausmann the amount of porphyrin in the urine was far less than in other recorded cases, so much less that it is with some hesitation that the diagnosis is accepted. Nevertheless these cases cannot be excluded" (Garrod).

Besides the variety of porphyrins and the variation in amount we must not forget the "other abnormal pigments of which as yet we know little." Hammarsten, quoted by Dixon Mann, says that the colour of the urine in sulphonal hæmatoporphyrinuria remains the same after the porphyrins have been extracted.

At present, therefore, we can only study the peculiarities of blackwater and hæmatoporphyrinuria to see if these support a *prima facie* case.

To what are "Relapses" of Hæmoglobinuria due?

"Who has had blackwater once is prone to have recurrences," says Deaderick, opening his paragraph on "Previous attacks." Every practitioner who deals with the disease is aware of this. The tendency to relapses of hæmolysis is acutest during the period of illness due to any given attack. After recovery the tendency is still present, as Deaderick says, but in the course of a few years wears away (if the patient survives). Deaderick,

instancing the number of attacks of several individuals, some running into the teens, closes: "The only immunity except natural being conferred by prolonged residence in an endemic focus."

There is therefore in blackwater an acute sensitization during the attack of a less acute and semi-permanent one afterwards.

Some years ago I had brought to hospital for treatment an extremely fair-haired lemon-tinted child of 2½ years with a very enlarged spleen. The relative implored me not to give quinine as "she could not take it." She was treated with great care for several days, and no quinine, in order to "get her into a better condition in which she could be started on quinine." This was years before I had any idea of a sensitizer, but it shows the attitude of mind of a practitioner. I started her on a small dose—I think half a grain—and she promptly had hæmoglobinuria, which lasted some twelve hours. After a few more days' rest I gave an intramuscular injection of about three grains. This also, to my surprise, produced the same effects. Then I remembered a case of urticaria in which quinine could not be taken without it developing, but the patient could take it in combination (tabloid form) containing one grain per dose with iron and arsenic. This plan succeeded in this case also, and the patient, though she has had some attacks since in which I have not seen her, is now a fine schoolgirl of twelve, has at last lost her enlarged spleen entirely, and can take her quinine with impunity. Such cases are not at all uncommon. Children do not have nearly such grave symptoms as adults with blackwater.

In the white mice experiments of Hausmann, if smaller (non-lethal, i.e., less than ⅛ grain), doses of hæmatoporphyrin are given or "the animals are kept in a feeble light, a definite syndrome or true light disease, is presented." . . . "*The effect of the infection wears off in time.*" In the clear-cut personal experiment of Meyer Betz he was rendered "hypersensitive to light for two or three months," yet "hæmatoporphyrin could only be detected in his urine during the first few days." In these cases there was no recurring, liver-disturbing infection, as in malaria.

A second difficulty arises in Garrod's statement that "sufferers from hæmolytic diseases and paroxysmal hæmoglobinuria do not excrete porphyrin in excess." In the preceding sentence he says: "All the available evidence tends to show that an excessive excretion of porphyrin does not imply excessive hæmolysis." Well, in one class of case Prof. Dixon (*vide post*) stated that "the patient may bleed half the blood in his body in a few hours," that is, the distinct class of hæmatoporphyrinuria due to sulphonal. It is perhaps not a hæmolytic disease, but it is a hæmolysis of a severe type.

Let us examine these statements, however. With regard to hæmolytic disease, no information is available whether any congenital hæmoporphyrinurics have died in early infancy as a result of hæmolysis. In the first few days of life there occurs normally a considerable reduction in the number of corpuscles per c.mm. Icterus neonatorum, implying hæmolysis, is very common, in this country at any rate. Hæmatoporphyrin is present in the meconium. Why should sepsis of the umbilical cord in particular cause hæmolysis?

Of the hæmolytic diseases paroxysmal hæmoglobinuria most closely resembles blackwater, and the very close similarity is freely admitted. Blackwater, however, is vastly more common than this rare condition, and though no hæmatoporphyrin has hitherto been found, I submit that, in spite of this, it is worth careful investigation in blackwater.

Hæmolytic diseases, so far as their ætiology is known, appear to be widely different in manner of causation to blackwater fever, with the exception of paroxysmal hæmoglobinuria.

But I must take cover in Garrod's very guarded closing words: "So the matter stands at the present time (1923), and it is obvious that much remains to be done. Only by the investigation of fresh cases in the light of the knowledge which is now at our disposal can we hope to solve the problems still outstanding."

Diversity of Degree and Manifestations in Hæmatoporphyrinuria.

Preceding this (remembering also the main classification of Gunther, with their wide diversity of symptoms), he quotes some of the remarkable variations in the manifestations. "Hydroa is not an inseparable accompaniment of congenital hæmatoporphyrinuria," as is shown by the case of the bearded woman.

"Yet although the natural cutaneous eruption and the symptoms induced experimentally are not comparable phenomena, we cannot doubt that the sensitiveness to light which results from the presence of porphyrins in the tissues is the cause of the hydroa and the failure to reproduce the natural syndrome is presumably due to faulty technique."

"It is more difficult to explain the apparent discrepancies between the degree of porphyrinuria and the severity of the hydroa": Arzt and Hausmann's cases already quoted are instanced.

"In some cases, notably in one of McCall Anderson's, the urine is said to have been of normal colour between the attacks, and in others also it would seem that exposure to bright light causes both the porphyrinuria and the hydroa."

"Fischer suggested that the explanation of such observations may lie in the presence in the tissues of a chromogen of the porphyrin, a colourless reduction product which does not sensitize them to light. Saillet demonstrated the presence of such a porphyrinogen in the urine. Schumm has shown that it is promptly converted into the pigment by potassium permanganate and slowly by the action of light." This, if correct, is very significant, suggesting the possibility of oxidation in the blood by luminous rays which penetrate the skin on exposure to fierce light. Colourless porphyrinogens in the urine would escape detection by spectroscopy.

It is difficult to summarize the situation emer-

ging from this evidence, however. Experimentally hæmatoporphyrin and light cause lysis in red blood corpuscles.

Hæmatoporphyrinuria is due to a lacking liver enzyme.

Extensive acute hæmolysis with hæmatoporphyrinuria occurs with prolonged sulphonal taking; indicating from foregoing damage to the liver.

Chronic hæmatoporphyrinuria results in sensitization and destruction of tissues exposed to light.

That while the congenital liver defect, with excess of hæmatoporphyrin in urine, is extremely rare, the presence normally of traces of such an active substance in the urine, fæces, bile and meconium indicates that the substance plays a by no means insignificant part in metabolism.

That along with this theorem must be granted the enormous importance of the correlative factor —" reacting substance "—which can oxidize the colourless porphyrinogen to that of the pigment—namely, light.

The part played by these factors in ordinary metabolism awaits investigation.

There is only one known manner—sulphonal taking—in which urine rich in porphyrin is producable, and it is not known precisely what the relation between the hæmolysis and the hæmatoporphyrin is.

The Action of Quinine on Protoplasm and on Ferments.

An extremely valuable discussion on " Quinine and its Related Alkaloids in Pharmacology and Therapeutics," which took place at the annual meeting of 1920 and covers the exceptional experiences and lessons of the war, must be referred to at length. We shall take first the pharmacological action of quinine, by Prof. Dixon, who opened the discussion, and then in connection with it the question of blackwater and the sulphonal-caused hæmolysis with its peculiar feature of hæmatoporphyrinuria.

" Quinine is peculiar among alkaloids in that it has no very definite specific action on any particular tissue in the body. Since quinine depresses all living tissues in much the same way, its effect should be clearly discernible in metabolism. Our facts in this respect are not uncertain, though it is not simple to understand their interpretation. Under the influence of quinine and its derivatives general metabolism is lowered, as shown by the diminution in the excretion of urea, sulphates, phosphates and chlorides in the urine. The diminution of urinary metabolites is of such a nature as to leave us no option in concluding that there is a diminished protein breakdown, and we might from this with some confidence prophesy that there would be a simultaneous diminution in the absorption of oxygen and carbon dioxide output. Such however is not the case; the gaseous metabolism is hardly influenced. Furthermore, in febrile conditions the temperature is brought down, though the heat loss is not increased; that is to say, there may be other important sources of heat in the body besides the oxidation of carbon compounds. These facts are true in health and fever. Quinine therefore prevents excessive protein breakdown. It is unlike arsenic and many other drugs in that it does not diminish oxidation, so that no danger arises from increased production of acid, lactic, butyric, &c., from the incomplete oxidation of carbon compounds " (*Brit. Med. Journ.*, July 24, 1920, p. 115).

Absorption and Excretion. (*Ibid.*)

" It has long been known that the liver destroys morphine, nicotine and other alkaloids, and we have reasons for believing that this action is due to a ferment. . . . Ramsden has performed a similar experiment with quinine, and finds that the liver, kidney and intestinal wall have considerable power to destroy quinine post-mortem, but that the suprarenal bodies, spleen, bone marrow, &c., have not this property. It will be noticed here that the quinine tends to collect in high concentration in the spleen and suprarenal organs, and that it is just these organs which are unable to destroy it."

Prof. Ramsden, who followed, said: " Quinine is very rapidly destroyed by liver pulp. One of the products is quitenine."

It used to be taught that " Quinine is therefore very constant and very powerful in interfering with oxidation," but now we know, whatever the explanation may be of the temperature reduction, that this is not the method.

Prof. Dixon discusses quinine and blackwater with diffidence. " The story of the attack is clear in its suddenness, and points to a sudden liberation into the blood of poison which destroys the corpuscles. Many such poisons are known, but quinine is not one of them. Sulphonal given daily in large doses accumulates in the tissues, and the patient may be free from its ill effects for weeks, but on the sulphonal attaining a certain concentration it suddenly acts, and the patient may bleed half the blood in his body into the urine in the course of a few hours."

Sulphonal Hæmolysis and Hæmatoporphyrinuria.

He did not refer to the question of the hæmatoporphyrinuria associated with this delayed sulphonal poisoning, which one wishes he had done, nor did any of the others. Why should this feature be present with this particular cause of hæmolysis? Is the porphyrin merely *post hoc?* The experimental evidence submitted by Garrod that hæmatoporphyrinuria is due to some liver defect, probably an enzyme lacking, is fairly conclusive. In sulphonal hæmolysis, therefore, does this defect only appear after, and as a result of, the hæmolysis? If so, porphyrinuria should be constant with such hæmolyses. But if, on the other hand, sulphonal produced a special degenerative change in the liver cells, involving the production of a morbid quantity of porphyrin, not noticeable till the crisis occurred, but sufficient to cause sensitization to light, naturally we would, after the hæmolysis, get a urine very rich in porphyrin and attracting attention. And it would

then be assumed because *post* to be *propter hoc* also.

This hypothesis may be rather jumping to conclusions, but the grounds seem reasonable. At any rate it may be useful to assume it for the sake of conclusive investigation of the point. Should it be proven to be so, we would have a case of hæmolysis due to sensitization instead of hydroa and other syndromes.

It is further suggested that with recurring attacks of blood destruction, as by malaria, *vice* sulphonal, in which the liver undertakes the chemical clearing-up of the pigment debris—there is histological evidence of cell degeneration—that a sudden lowering of its already embarrassed activity by such means as quinine may interrupt the chemical changes of hæmoglobin into bilirubin and allow the production of this intermediate substance.

" Quinine retards all vital processes."

" The synthesis of hippuric and salicyluric acids by the surviving kidney is stopped by minute amounts of quinine. The action of quinine is therefore not confined to intact protoplasm, but extends to the ferments." (Dixon: *ibid.*)

" Washed tetanus spores given hypodermically to guinea-pigs or monkeys do not produce tetanus; if quinine is injected into the animals the day before or the day after the spores are injected, then tetanus is contracted (sample). Other alkaloids like morphine have not this action." (Dixon: *ibid.*)

Thus we have ample and definite evidence of the depressant type of action of quinine.

In the same category of lowered hepatic activity may be placed the other specially noticed immediate antecedents of the onset of blackwater, such as chill from a sudden wetting and exhaustion due to unusual exertion. And we have also by the same token an explanation of the fact that in non-malarial conditions and in malaria, when blood destruction is not actually in progress, no hæmolysis follows the use of quinine.

Statement of Theory.

My paper is already too lengthy. For some years it has been borne in upon me, from many observations which cannot all be detailed here, that there was some relation between light and the development of blackwater. Such connection could not, of course, be of a simple nature; it could only be associated with the occurrence of a morbid condition. Obviously that morbid condition must be malaria, by its peculiarities of association.

With due diffidence I suggest that the hæmolysis which constitutes blackwater fever is due to the presence of an optical sensitizer, probably one of the porphyrins, which is developed under certain conditions, causing lowered hepatic activity in the course of the active stages of malarial blood-destruction. The relations between the substance postulated, light and the red blood corpuscles are of a nature, according to the following summary of such processes, as laid down by Sir Wm. Bayliss:—

" Optical sensitizers belong to the class of catalytic light reactions. A system, insensitive to light of a particular wave length, can be made sensitive to it if a dye be present which absorbs this wave length. Since the light is absorbed by the sensitizer, it must act by means of the changes produced in this, resulting in the formation of some substance, frequently active oxygen or some catalyst, which acts on the system, which is by itself insensitive to the particular light in question " (p. 577) (26).

While not excluding simple photo-chemical action on hæmoglobin from a possible, predisposing share in the process of this hæmolysis, it is to the different, " trigger-like " action of a photo-dynamic sensitizer I attribute its occurrence. The investigation of the conditions which render such action possible are not less important than the discovery of the actual trigger.

Without going into any further analysis beyond that contained in the descriptions already mentioned of the circumstances in which blackwater occurs, I submit that we have here an hypothesis which fits like a glove to the facts of what Sir David Bruce calls " the conundrum of blackwater." How else can the co-relationship of the curves of malaria and blackwater shown by Thomson to exist be explained, and at the same time the disparity between the number of infected corpuscles and the extent of the hæmolysis, along with its inconstancy of development in malaria—its association with mild malaria and exceptional exposure to light and such circumstances as the use of a drug which depresses the vital activity of protoplasm and ferments, and finally with the sensitization which follows a first attack?

We come back to that most valuable simile of Manson, expressed in this country actually, of the oak and mistletoe, the former representing malaria and the latter the blackwater. Malaria is the primary condition, but again I refer to the fundamental significance of light action—just beginning to be understood and correctly appraised. My endeavour, though I confess to a sense of its inadequacy, has been to present the *a priori* evidence for the hypothesis stated and to indicate the satisfactory manner in which it explains the observed circumstances of the occurrence of blackwater. Proof of its correctness my limitations do not enable me to submit, but I feel confident that it will appeal strongly to those in practical touch with the disease. I trust that it will be fully investigated and hope that it may lead to the removal of the principal incubus to rural settlement of one of the otherwise most exhilarating climates in the world.

The question of the dynamic effects of light energy on the animal half of creation opens up a vast and, be it admitted, difficult field for research in physiology and pathology, one which may prove specially valuable in the problems which chemotherapy, as recently expounded by Dale, has to solve, while should it be proven in the future that catalytic light reactions occur it must have a bearing on the problem of the mechanism of evolution.

I am indebted especially to the great work of Sir Wm. Bayliss, " General Physiology," to Garrod's important work, standing like a finger-post on the road, and to the stimulating monograph by J. R.

Fulton, for many data which give a solid basis for the views expressed here, and to the last-named and Sir Arthur Shipley for kind encouragement in this study.

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Some Observations on Blackwater Fever (E. P. Carmody, *Brit. Med. Jour.*, January 17, 1925).—Observations on thirty-six consecutive cases of blackwater fever in Southern Rhodesia are given, also an account of the method of treatment used. The conclusions of these observations are that a case of blackwater fever should never be moved if it can be avoided, and then only with the greatest care and for the shortest possible distance. No case should be moved for at least fourteen days after the onset, however slight the case may be. If possible a trained nurse should be obtained to see that the treatment is properly carried out. If subcutaneous saline injections are given at once the urine will clear up more quickly. The author feels confident that quinine does not cause this disease, or even act as the fulminant, and thinks the reason this idea has been entertained is that, the premonitory symptoms being indistinguishable from malaria, quinine is taken, and the onset of blackwater is credited to it. That blackwater fever is undoubtedly due to malignant tertian malaria has been conclusively proved by Professor J. G. Thomson, of the London School of Tropical Medicine, during his recent researches in Rhodesia. The prevention of malaria, and therefore of blackwater, lies in the hands of the colonists, if they will only take the extremely valuable advice published for their benefit by Dr. A. M. Fleming, the medical director for Southern Rhodesia.

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A WHITE AUSTRALIA: IS IT A POSSIBILITY?

By SYDNEY J. SKERTCHLEY, J.P.

(*Continued from page* 97.)

CHAPTER VIII.

The United States and Canada.

138. The unparalleled success of the United States seems, at first sight, to settle in the affirmative the question we are trying to solve.

The growth of the United States has been phenomenal, and to none does it appeal so powerfully as to those who, like myself, have seen the expansion of that great land and of Canada, and have watched the wilderness give place to township, to city, to thriving agriculture and the teeming population of mining centres. But yesterday, it seems to me, and Chicago was still spoken of as the Far West. To-day the Far West is almost a memory of the past. There are millions of good Americans who never set eyes upon a cowboy, save in the Wild West show, and there are more millions who have never seen a Redskin at all. "The Britishers licked the world, and we licked the Britishers," is no empty vaunt; and we Australians are still enthusing over the visit of the American fleet, a body that had practically no existence twenty years ago. I remember when the American flagship in Chinese waters was the old "Monocacy," a wooden paddle steamer, that dare not put her nose outside a harbour if it blew a capful, and whose top speed was about five knots. I saw the first American ironclad come into Hong-Kong, and her engines had well-nigh torn her plate rivets out. I, at any rate, can appreciate the wonderful advance of the United States. Is it permanent?

139. President Roosevelt put the case in a nutshell: *America cannot fill her own cradles.* She has depended on immigration, and this artificial increase cannot be maintained. Europe cannot stand the drain, and the rate of immigration has steadily declined. In 1893 the returns showed a decline of forty-two per cent., and last year so great was the deficiency that the huge German steamship companies for the first time failed to pay a dividend, and expended all their reserve capital. The North German Lloyd Company alone lost £892,000 in the year 1908. Their total earnings were but £460,900, as against £1,634,850 the previous year. Their steerage passengers were 185,000 less than in 1907. In 1907 the two chief German and two chief English steamship lines carried as many as 605,535 passengers, in 1908 the number had fallen to 175,518, a decline of no less than 430,017. The Cunard line did not actually make a loss, but, owing to heavy decreases, failed to pay a dividend. The directors say that "the total number of passengers landed at New York and Boston fell from 1,116,000 in 1907 to 335,000 in 1908," a decline of 781,000.

140. Of course, there were exceptional conditions prevailing, and all the passengers are not immigrants. But, allowing for this, the decline in the number of immigrants is part of a steady decrease that has been going on for years. Between 1893 and 1902 the immigration returns show a decline of forty-two per cent., and the decrease continues, though nothing like the late sudden drop in numbers has occurred before nor is likely to be repeated. Still, it shows how artificially bolstered up is the present system of immigration, it is no longer spontaneous.

141. Even to keep up the numbers of this declining migration great and artificial efforts had to be made. The exodus from Europe was ceasing to be spontaneous, and the great German shipping firms have flooded Europe with agents who, as recruiting sergeants, will lay the most tempting, and not always strictly veracious accounts of the wealth, or at least the comfortable existence that was the lot of all in those far fields that are always fairest. During a recent visit to Holland, Germany and Austria, this fact was driven home to me. It is hardly overstating the case to say that, for instance, in every little town in Bohemia these shipping firms were better advertised than in Brisbane, and the allurements were set forth in artistic posters, in attractively written pamphlets, and agents and railways vied with one another to make the would-be wanderer's ways paths of pleasantness. There was a Moses in every hamlet ready to conduct the children to the promised land —for a fee. And this is how the United States have for some years been stocked; these are the recruiting wiles that have filled the ranks of an army that was always being decimated at the front.

142. From 1654 to 1800 the immigration amounted to some 600,000, or say, 4,000 per year. By that time the natural increase of the English population of the States had become almost phenomenal, and justified Jefferson in prophesying that by 1875 his country would contain eighty million inhabitants. Franklin called the world's attention to the wonderful fecundity of the colonists; in some parts the population had doubled in twenty-five years, and at the beginning of the last century the States held some five and a half million of people. But this state of things was only temporary. In 1860 a most exhausting search was made of town records in the New England States, "when it was discovered that the first generation of Americans had families of ten and twelve; the second, third and fourth, families of seven and eight; the fifth, families of four and five; the sixth, families of three and less." Indeed a report by Dr. Jesse Pickering to the city government of Boston, in 1851, had already shown that there was no natural increase in the strictly American population. I am chiefly indebted for these and other statistics to a remarkably able paper by Mr. J. Waston, in the *Nineteenth Century* review of December, 1902.

(143) The fact is that the White Race, like many introduced plants and animals, tends to run riot in fertility when transplanted into new soil, but by the very effort they expend their vital energy and a deadly reaction ensues. If the American soil is so fitted for us Fair Whites we ought to prove it in the case of Massachusetts. Yet its life-blood has been foreign these fifty years. In 1900 the population was 2,805,346 of which 1,743,710 were foreign born or of foreign parentage; that is out of every ten six were foreigners. As Mr. Waston says, "To put it shortly, two hundred and seventy-five years after the landing of the Pilgrim Fathers the stronghold of Puritanism is held, not by the ever-declining American, but by the Irish, the German, and the French Canadian."

(144) Nor is this decrease due to the opening up of the West by the eastern Americans. These lands have been peopled rather by Old England than by New England. The population of Illinois, which includes the great city of Chicago, was in 1902, 4,821,550, of whom less than half are of native American stock.

(145) The decline in the native birth-rate began in the second decade of the last century. "As late as 1840 the increase in the population by reproduction was 28·01 per cent., by immigration 4·66. By 1890 the first had dwindled to 14·40 and the second had increased to 10·4." In New York in 1890 the registered births of Americans was 27 per cent. and of foreigners 73 per cent. of the whole. So one might go on, taking city after city, State after State, always with the same result, that there is no natural increase of the native American, and that the population is only kept up by immigration. This is not due to any diminution of the virility of the Fair Whites as a whole: on their own soil they are steadily increasing as the English statistics show. Old England has not only filled her own shires, but has sent her surplus abroad over the world in greater numbers even than to the United States.

(146) But even with the enormous influx of foreign blood the States have not maintained their anticipated increase. It was faith in this steady increase of the Fair Whites that alone permitted the formulation of the Monroe doctrine of "America for the Americans." Unless the Americans could more than hold their own the cry was absurd. President Roosevelt said "I believe in the Monroe doctrine with all my heart." Yet soon after, and many times, he has had to insist that, "A man to be a good citizen must first . . . be a good father; I hope the father of many children." Why this appeal, this half despairing cry, if he did not realize that it was in the cradle and not in the immigration bureau that the future greatness of his country lay?

(147) According to actuarial statistics the population of the United States in 1893 should have been 100,000,000: it was only 63,000,000: a shortage of 37,000,000. And of this population nearly 9,500,000 are coloured people, negroes or Asiatics. In 1900 the population was 76,000,000, but as Mr. Waston shows "it can readily be seen that only half the population of the United States is American in the true sense of the term." From 1850 the foreign birth-rate has gained on the American until now it is four times as rapid. This does not mean that the foreigners are naturally more prolific but merely that on the new soil the stimulus is being felt, as it was by the English of the earlier date: the foreigner himself will slow down in his rate of natural increase. A writer in the *Popular Science Monthly* goes so far as to aver that "we have not so many people as we should have had if immigration had never come to us, and the native stock had continued their old rate of increase." This is undoubtedly true. No nation can possibly maintain itself by immigrant accessions: the native stock first dies, the newer stock succumbs in like manner after awhile; and the issuing countries become exhausted. The armies of immigrants lose nearly every battle, and the mother countries cannot stand the strain and drain of incessant recruiting. The solid glacier ice, impelled by gravity, supplied by annual snows, can protrude its foot into the midst of the vineyard, but an unseen foe inexorably slays the advance guards: and in the human glacier the recuperating snows are not inexhaustible and the ice-foot melts as before.

(148) We have already (pars. 139—142) demonstrated this last fact: we have now to illustrate an alarming danger in the character of the immigrants themselves. The real stamina of the Americans is derived from their Fair White blood; they are heritors with ourselves of all our glorious traditions; their law is our law; their polity our polity. Nothing, under present conditions, can bring us into armed conflict again. Only this week the English Premier called attention to the significant fact that the increase of the American navy was not a menace but a strength to England, and that the number of her warships would not, need not, could not, be taken into consideration when keeping our fleet up to two-standard power. "Blood is thicker than water" was proven in Manila Bay as clearly as at the Taku Forts. But be it remembered it *is* blood that binds; if that blood be altered the whole condition is changed. Let us see if it is changing, and again I take my figures (which are official) from Mr. Waston.

(149) Here is a table showing the numbers and nationalities of the immigrants from Europe to the Republic during the last two decades:—

Year	British Isles	Germany	Scandinavia	Russia	Italy	Austria-Hungary	Roumania
1881	153,718	210,485	73,597	10,655	15,401	27,735	—
1886	112,584	84,403	48,005	21,739	21,315	28,680	—
1891	122,085	92,247	41,002	43,880	51,799	56,199	517
1896	64,827	31,185	30,062	45,828	68,060	65,103	785
1901	48,237	18,507	28,225	90,789	100,135	114,847	6,459
1902	45,273	28,304	48,378	107,347	178,372	171,989	7,196

(150) This is an appallingly significant table. The first three columns may be taken as representing the Fair Whites, exclusive of the Slavs, and the last three the Dark Whites. For our purpose we must take the first three in contrast with the last four, for the Slavs have no connection with the Anglo-Saxon (Teutonic) stock. That is to say, that whereas in 1881 the emigration from south-eastern Europe was only 12 per cent. of that from Britain, Germany and Scandinavia, by 1902 it was double that of the Fair Whites.

(151) Mr. Waston puts the case thus: "The stream of British emigration to the United States has thus declined to less than one-third of what it was in

1881, Scandinavian to about two-thirds, and German to less than one-seventh. On the other hand, the stream of Italian immigration is more than eleven times greater than it was twenty years ago, Russian ten times, and Austro-Hungarian six times. Roumanian immigration, which in 1881 was so small as to be included in official returns under the heading various nationalities, increased nearly fourteen times. The number of Scots who settled in the United States in 1882 was 16,441. It is now 2,560, and last year (1901) was 1,000 less. The number of English immigrants has declined from 77,570 to 13,575. It is therefore evident that the only people of Teutonic origin which goes to the United States in anything like its former strength is the people of the Scandinavian peninsula."

(152) Between 1820 and 1899 no fewer than 19,050,328 persons settled in the United States, of whom over 6,250,000 were Germans and Scandinavians. The bulk of the immigrants came from western Europe: since 1893 the tide has changed. "As long," says our much-quoted author, "as the new blood poured into the United States was largely of Teutonic origin, she could look into the future without misgiving, but now that it is a mixture from Southern and Eastern Europe, it is another matter. Rightly enough the Republic prides herself on her Anglo-Saxon spirit, and creative force, and admits that it is essential to her wellbeing to preserve her racial affinity with the mother country. . . . It is these who made the United States what it is, not the people of South-Eastern Europe, and by them it will be [rather, can be] alone maintained. Hence the anxiety of thoughtful Americans as they perceive more and more clearly that the Old World no longer sends to them of her best." I would that Mr. Waston's thoughtful paper were studied by every Australian. I had arrived at my conclusions before discovering it, and am pleased to let so calm and able an expositor take this action practically out of my hands.

(153) The United States are getting further alarmed at the vast influx of Americans into Canada: a few years ago the tide was all the other way; but upon this we must not enlarge. Still the question will be asked, have we been more successful in Canada?

(154) Canada has an area of close on 3,500,000 square miles, about one and a quarter the size of Australia. Her population in Jubilee year was about 4,400,000, or say twice that of Australia at that date. Yet her first permanent settlement was almost exactly 300 years ago (1608). Surely this is not any very striking proof of natural increase; and Canada has received her full and continuous gift of immigrants. But this refers to the Dominion of Canada, which only came into being in 1867, prior to which Canada was only about 1,000 miles long by from 200 to 400 miles broad, and was divided into Upper and Lower Canada.

(155) M. de Quatrefages cites the French Canadians and Acadians (Newfoundlanders) in proof of French blood being able to sustain itself on American soil, and as practically there is no French migration whatever to Canada or Newfoundland, the case is a good one.[1] Let the learned French savant be heard first.

(156) Criticizing Dr. Knox and those who see things as I have been compelled to see them, he proceeds: "If the human current, which sets from Europe towards the colonies, were to be stopped, they maintain that the population would rapidly diminish, and the local races would regain the ascendancy, that the United States would return to the Redskins, and Mexico to the descendants of Montezuma." I break the quotation here to remark (1) that as the Paleface has destroyed the Redskins' food—buffalo, deer, bear, &c., this is not a fair statement, and (2) what he thought impossible of Mexico when he wrote in 1886 has come to pass before 1908. But to continue.

(157) "This assertion will be easily answered by a few statistics. They are taken from the history of the French races, which, since the Treaty of Paris in 1763, have, although in a slight degree, directly contributed to the peopling of Canada. There were in this country:—

In 1814	...	275,000 inhabitants of French Origin	
,, 1851	...	695,945 ,, ,,	,,
,, 1861	...	1,037,770 ,, ,,	,,
In Ottawa State there were:			
In 1851—Total population	...	... ...	15,000

"The history of the Acadians furnishes statistics which are quite as convincing. From the information obtained by M. Rameau, it appears that the entire population was descended from forty-seven families, numbering 400 souls in 1671. In 1755 there were 18,000. Dispersed and driven out by the English they were reduced to only 8,000. In 1861 the number rose to 95,000 persons" ("Human Species," p. 215).

(158) We will take the case of Canada first, and admit the correctness of M. de Quatrefage's figures; and also that since the land became British France has not materially contributed to its population. He shows that in forty-three years the French have increased by 762,770, an average of 17,739 per annum. Now the census of 1876, the latest available to me giving details, returns the French population as 1,082,940, or an increase of only 3,011 per annum. If M. de Quatrefage's figures are right here is a terrible falling off: if they are wrong they cannot be used in argument. But let that pass. Surely the fact that in 300 years the French population has only grown to little over a million is significant.

(159) With respect to Newfoundland, the French author's figures are clearly incorrect, of course quite innocently. So far from there having been only forty-seven families and 400 souls in 1671, we have an official record that in 1654, or sixteen years earlier, there were 350 families, numbering 1,750 souls, settled in fifteen settlements on the east coast. By 1680

[1] In 1901 there were only 7,944 of French origin, as against 27,300 Germans and 31,231 Russians in Canada, and no less than 386,545 from the United Kingdom.

the number of persons had risen to 2,280, by 1763 to 7,000, and the numbers rose steadily till in 1883 the total (not merely French) population was about 185,000. Taking this entire French and British population we find the rate of increase was :—

Between 1845 and 1857	25 per cent.
,, 1857 and 1869	18½ ,,
,, 1869 and 1874	10 ,,

These official figures most certainly do not confirm the French writer's statement.

(160) I gladly, even proudly, admit that the native-born Canadian, British and French, have not deteriorated in intellectual powers. I think they have proved themselves the wisest and most far-seeing colonists the world ever saw, and that splendid French-Canadian-Britisher, Sir W. Laurier, is assuredly a world-compeller of the first rank. I am not so certain about the physique; it is hard to judge in such a mixed community, but I incline to think it too has maintained its vigour in the land of the maple-leaf. But a man to possess a fine physique and a strong intellect must get himself born to start with, and statistics do not show the Kanuck to be a better cradle-filler than his American cousin the other side of the forty-ninth parallel. If my supposition be true then Canada is the happy hunting-ground of the would-be pioneer.

(161) The typical Yankee, as he depicts himself, the Uncle Sam of his own cartoons, shows that he has spindled out in the air of the States. He is lank, shambly, and goat-bearded; he even depicts himself as becoming hawk-beaked like the Redskin he exterminated. Nations do not willingly libel themselves, especially people as sensitive as the Americans, and yet their ancestors were the sturdy, farmer-like John Bulls delineated as the English type alike in London's *Punch* and New York's *Puck*.

(162) Canada's population is now considerably over 4,000,000, exclusive of some 85,000 Indians. But she has not peopled it with her own blood. An analysis of the 1876 census makes this startlingly clear, and this is before the recent great influx from the United States, which now amounts to several hundred thousand. Here are the figures :

French population	1,082,940
United States immigrants	64,447
Irish	850,000
English	700,000
Scotch	550,000
German and Dutch...	230,000
African (negro)	22,000
Welsh	7,800
Scandinavian	7,000
Italian	1,000
Spanish	900
Total ...	3,516,087

If we deduct the French, who are natives, and the United States whites and negroes, who are American born, we have a non-American addition of 2,346,700; that is to say every other person in the Dominion was born in Europe.

(163) But this is hardly fair to Canada. It supposes that she kept all her children at home, like the United States, and did not supply immigrants to other countries. Such is far from being the case. Canada was rather sore when the neighbouring Republic in 1882 said that over 70,000 Canadians had settled in the States; but facts cannot be denied, and the 1890 census showed how great the exodus had become. It recorded 980,938 American citizens of British North American birth, and estimated there were nearly as many of Canadian extraction. Hence one must add nearly 2,000,000 to the figures above given. Canada had copied the Mother Country in sending forth her young sons, but she felt the strain, and made a mighty and successful effort to keep the young folk at home. Since 1890, she has reaped the benefit of her statesmanlike, far-seeing policy, and the tide of immigration has set the other way, till now it is the States that are apprehensive.

(164) Still this was only an ebb and flow across an arbitrary border; it was a tide on American soil; and does not affect our argument. The glaring fact remains that both the Dominion and the Republic viewed with alarm the crossing of their own peoples over the frontier. They knew they could not afford it, and this is the most significant fact of all. The old country was so fertile that though she sent out but 100,000 in the years 1815-48, in 1847 alone 258,270 persons left her shores, and between 1860-73 the annual average was no less than 274,645. Between 1820 and 1869 Great Britain sent 1,303,959 colonists to British North America, and 971,285 to Australasia, and benefited instead of being crippled by the effort.

(165) Now observe what this means. It shows that neither the United States nor Canada, collectively or individually, is in the condition to take up the rôle of England as mother of nations. They have received much and have given nothing in exchange, for they had nought to give. Cut off the supply of immigrants and North America would be paralysed. I do not think the United States would survive; I am not so sure about Canada, and for the following reasons :—

(166) If the United States and Canada had a physiographic instead of a political frontier, it would not be drawn along the 49th parallel, but along the waterparting of the rivers draining into the Arctic seas. This is, broadly speaking, a northward sloping plain that is swept by the cold north winds; and it is the wheat land, as distinguished from the maize land to the south. In other words, it is the exact counterpart of the native home of the Fair Whites, and here, if anywhere on earth, he has a fair chance to establish his race. I fancy he will and can; I am afraid he will not and cannot, in the less rigorous United States proper. And if these cease to be Fair White, then good-bye to the Monroe doctrine, good-bye to the blood-thicker-than-water federation, good-bye to all that has made the American, as he proudly calls himself, the amazing giant that he is.

Annotations.

Nervous and Mental Complications of Antityphoid Vaccination (G. Rousselet, *Thèse de Paris*, No. 129, 1924).—Nervous and mental complications in typhoid fever are rare. Among more than 3,000 patients admitted to the Nantes Psychiatric centre from 1914 to 1919, Benon found only four or five cases in which the origin of the affection could be attributed to this cause. Only five cases, in which neuropsychic symptoms developed after antityphoid inoculation, occurred at the centre for psychoneurosis of the military Government of Paris in 1916. Eleven cases have been observed by Mairet and Pierou.

Ectopic Gestation in Chinese Women (Arthur W. Woo, M.R.C.S., *The Journal of Obstetrics and Gynæcology of the British Empire*, No. 3, vol. xi, November, 1924).—Ectopic gestation occurs frequently in China. Probably its incidence there is about the same as in the countries of Europe. It is found in all the provinces of the Republic. Its features are the same as in the West, but owing to the reluctance of many patients to come to hospital or submit to operative procedures, a large number of cases never come to light and some are admitted to hospital only after the trouble has been allowed to drag on for some time. When the cases are submitted to immediate treatment the results are as good as those obtained in the West.

Korsakoff's Psychosis and Typhoid Fever (P. Gerbeau, *Thèse de Paris*, No. 203, 1924).—The author records an illustrative case, and states that typhoid fever may be complicated during the acute stage by a number of mental disturbances, the commonest of which being mental confusion, ill-systematized hallucinatory delirium, and Korsakoff's psychosis. The essential features of the latter in typhoid fever, as in other infections and intoxications, are amnesia of fixation, fabulation, false recognition, and euphoria. As a general rule Korsakoff's psychosis in typhoid fever is not accompanied by polyneuritis, which is not an essential feature of the syndrome and may be absent in other infections and intoxications. The prognosis is usually grave. The treatment should be carried out in a psychiatric clinic and not in an asylum.

Some Etiological Factors of Tuberculosis in India in General and in Bengal in Particular (Ashutosh Roy, *The Indian Medical Journal*, No. 11, vol. xliv, November, 1924).—Tuberculosis is on the increase in India especially in Bengal and Calcutta. The author states that it is wrong to ascribe it to one etiological factor. The immediate cause is the entry and lodgment of the bacilli in the organism, rendered suitable for reception of the germ by a multiplicity of causes, which he enumerates; among them, change of country life for the city the debilitating effects of malaria, the miserable economic conditions of the middle and poorer classes, insanitary public restaurants, &c. In Bengal the chief cause of the disease is protein insufficiency. Tuberculosis should be studied from social, economic, racial-atmospheric and climatic points of view, besides the bacteriological, to prevent further spread of infection.

Pulmonary Infection with the Spirochætæ and Fusiform Bacilli (Clyde McNeill, *Johns Hopkins Hospital Bulletin*, November, 1924).—The spirochætæ and fusiform bacilli are widely distributed throughout the world, and have been known to cause a great variety of lesions in the human body, including infections of the skin, external ear, middle ear, gums, mouth, throat, gastro-intestinal tract and bronchi. To this list is added an infection of the parenchyma of the lung—a disease that may be clinically and roentgenologically indistinguishable from pulmonary tuberculosis, but which is easily diagnosed from a stained smear of the sputum, and heals like magic under intravenous salvarsan therapy. A case is reported in detail with full clinical, laboratory and X-rays studies.

Oleum Morrhuæ in Typhoid Fever (Kartic Chunder Dutt, *Indian Medical Record*, No. 11, vol. xliv, November, 1924).—The author has used cod-liver oil in numerous cases of typhoid and paratyphoid fever during the last twenty years, and has found this method of treatment appreciably diminishes the mortality in these maladies. It supplies the fat and vitamin necessary to make up for the tissue waste which inevitably occurs in all cases of fever.

Correspondence.

DISEASES OF CENTRAL AMERICA.

To the Editor of the JOURNAL OF TROPICAL MEDICINE AND HYGIENE.

SIR,—I was much interested in reading in the issue of the JOURNAL OF TROPICAL MEDICINE AND HYGIENE for January 1, 1925, the paper by Dr. Castellani relating his observations on some of the diseases of Central America. As I had the pleasure of visiting and working for some time in British Honduras in 1923, perhaps I may be permitted to detail a few observations I was able to make on certain of the disease conditions mentioned by Dr. Castellani.

Filariæ.—I was not fortunate enough to meet with the interesting condition described by Dr. Castellani as Guatemala onchocerciasis, but apparently its geographical distribution, as far as it is at present known, is a very limited one. Moreover, it is to be noticed that all reports on its occurrence appear to show that it occurs in individuals living at a considerable altitude. In British Honduras the vast bulk of the population

live on the low-lying lands, and in the interior where higher land is met with the population is extremely scanty; no case of nodules on the scalp was ever seen by me, and even if such a condition exists in British Honduras it must be extremely rare.

I quite expected, however, to find cases of infection with other filariæ, especially *Filaria bancrofti* and possibly *F. perstans* (*Acanthocheilonema perstans*) seeing that these organisms are met with in many of the southern of the West Indian islands, and especially in British Guiana. Although I examined over 200 individuals, including patients in hospital, and inmates of poor houses and the lunatic asylum, I was not able to find a single case of infection with any filariæ.

No condition suggestive of filariasis was met with, and the annual medical reports of the colony over several years, which I was able to study, make no mention of the condition.

Medical men in practice for a number of years in the colony assured me they had never seen any indigenous cases.

In British Guiana many of the wild birds harbour filariæ of various species, which appear to be peculiar to birds and not capable of infecting man. In order to ascertain whether the birds of British Honduras were likewise affected, I shot a large number of different species of birds and submitted them to examination. In only one instance was I able to find microfilariæ in the blood. These occurred in a species of water-hen, known locally as the "Two-penny Chick." In passing, it may also be noted that it was quite common, in the blood of birds in British Guiana, to find some species of *Plasmodium*, but none were ever seen in the blood of any birds I examined in British Honduras.

Myiasis.—I was fortunate in coming across several cases of this condition, all of which presented the "boil-like" type described by Dr. Castellani. In one case I was able to hatch out the fly from extracted larvæ. Having obtained some mature larvæ from a case, I induced them to pupate in a dry bottle with some cotton wool. Having within two days passed into the pupal stage, they remained in this stage for almost exactly a month, when the adults hatched out, presenting the characters of *Dermatobia* (? sp).

The maggot is known locally as the "beef-worm." I was much interested in the possible way by which man became infected, and had the opportunity of discussing the matter with an extremely observant Government officer. His duties necessitated frequent journeys into the unfrequented hinterlands where he often had to literally hack his way through dense bush. His clothing consisted of a bush shirt, widely open at the neck, and riding breeches, with the usual covering of the legs and feet. He was in the habit of wearing a belt around the top of his breeches.

Each time he came back from his expeditions he was the unhappy host of some ten or a dozen or more of these "beef-worms," which almost invariably were embedded in his body just above the line of his belt. He stated it was his belief that the eggs of the fly were deposited on foliage, and that in cutting his way through the bush the eggs fell off on to him. Some of these would fall on his neck and upper part of his back, and would get inside his shirt and come to rest just above the constriction of his belt. The heat of his body would hatch the eggs, and the larvæ would proceed to bore into his flesh. He had also noticed that if he went without his belt, it would appear that the eggs were able to make their way down his legs, until obstructed at the knee by the tight-fitting breeches. It such cases the maggots were found embedded in the flesh at that position. He did not consider that the infection was obtained through the intermediary of any biting insect, e.g., *Janthinosoma*.

Leishmaniasis.—No instance of the Brazilian type of leishmaniasis known as espundia was met with, but a form of ulceration almost certainly leishmanial in nature, and known locally as "bay sore," was met with on several occasions. This form of ulceration, which clinically is indistinguishable from leishmanial lesions, commonly attacks the ear and more especially the lobe, from which it slowly invades the surrounding part. The condition is a very chronic one, but will eventually heal with the loss of a considerable part of the external ear.

It appears to chiefly attack people engaged in mahogany cutting, or in the collection of chicle (gum used in the manufacture of chewing gum), and whose work is carried on in the bush. Although I am convinced that the condition is a manifestation of leishmanial infection, I was unable to demonstrate the causative organism in scrapings of the sores, but this failure was in all probability due to the fact that all the cases I saw had existed for many months, and, as is well known, there is often a great difficulty, or even impossibility, to detect the organisms in such cases.

Unfortunately I had not the means at hand to undertake cultural experiments. Two cases of what Dr. Castellani described as the oriental sore type, were seen, the lesions in each case being on the back of the hand.

The treatment most favoured for these cases consisted of the injection into the periphery of the sores of a solution of emetine, and certainly, in my experience, it worked very well.

Pinta.—Several cases of this interesting condition, attacking the forearms and backs of the hands and also the lower part of the leg and dorsum of the foot, were seen. The manifestations were all of the black and white patchy variety. Opportunities for cultural work were not available.

It is interesting to note the native's idea as to the cause of this condition. One and all firmly believe that it is caused by the consumption of the flesh of the "mountain cow." What this particular animal is, I am not quite sure, but as far as I could ascertain it seemed to be the tapir. Be that as it may, it is firmly believed that the eating of the flesh of this animal is invariably followed by the appearance of pinta.

I am, Sir,
Yours truly,
H. B. NEWHAM, M.D.

23, *Endsleigh Gardens*,
Euston Road, *N.W.*1.
February 27, 1925.

Original Communications.

A CLINICAL STUDY ON MALARIA IN THE NEAR-EAST AND IN EUROPE.

BY

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INTRODUCTION.

THE Investigations of which we publish the results lasted upwards of ten years. Some of them were made in the Malarious Centre (Orient Army) of Gradobor, a village fifteen kilometres from Salonica, in the marshy valley of Galliko, which centre was under the direction of one of us from July 1, 1916, until September 1, 1918.[1]

To the observations made at Gradobor are added those touching the numerous malarial patients treated by us before, during and after the war in Europe and who contracted the disease in the Near-East, Southern Russia, Poland, Roumania, Holland or along the Rhine.

It amounts, therefore, to a study of the types of malaria met with, especially in the Near-East and around the Mediterranean Basin generally, to the exclusion of tropical malaria.

In these parts, as also in those European countries where malarious centres still exist, two main forms of this malady are found: the form due to *Plasmodium vivax* and the one due to *P. falciparum*, whereas infections caused by the third variety, *P. malariæ*, are exceedingly rare.

Malaria, so far as it is a parasitic disease, comes under the general laws of all such maladies. It presents:

(1) Variations corresponding to the infecting agents predominating in given areas and at given times.

(2) Variations in the gravity of the infections.

(3) Variations as to the organ selected for attack: spleen, liver, bone-marrow, &c.

It ensues that:

(1) *Malaria cannot be studied and classified at a distance from its seat of evolution and predilection. This can be done with advantage only by long observation on the spot from the beginning, i.e., the infection period, until its time of full development and chronicity in one and the same individual.*

(2) *No exact knowledge can be had concerning the fate of malarial patients after their departure from the country where they became infected, except by keeping them under close observation for several years.*

If, as will be seen to be the case, the conclusions drawn by us from our observations do not always tally with generally accepted opinions, and even differ considerably therefrom in many respects, it is because the majority of writers who have studied malaria have ignored the above principles.

INFLUENCE OF ATMOSPHERIC TEMPERATURE ON THE EVOLUTION OF MALARIA.

Chart I, which is a document unique of its kind, was made in the hospital at Gradobor, and extends from July 1, 1916, to September 1, 1918; that is to say, twenty-six months.

It shows in the clearest way the influence of the several atmospheric factors upon the development of malaria.

This drawing has the following curves:

(1) *Upper Curves.*— These relate to malaria sufferers in whose blood parasites were found. The full curve indicates the *P. falciparum* cases; the dotted one those due to *P. vivax*. The indications are summarized by decades.

(2) *Middle Curves.*—By these are shown the maximum (dotted curve) and minimum (full curve) temperatures in the shade.[1]

(3) *Lower Curves.*—These indicate the rainfall, measured with the pluviometer.

(4) At the bottom of the drawing there are some general meteorological details as to wind, storms, snow and so forth.

The conclusions to be deduced from this drawing are the following:

There are two outbreaks of malaria per annum; a mild one in winter (February and March in 1916 *and* 1917, *April in* 1918), *and a severe one which attains its culmination from September to November. These two outbreaks have characteristics differing widely, as follows:*

(a) During the active period, lasting from February to April, the circulating blood is always found to contain *P. vivax to a predominating extent.*

(*b*) *During the severe increase in September-November the circulation contains a markedly predominating quantity of P. falciparum.*

Furthermore, P. vivax, which always appears first, begins to decrease when P. falciparum makes its appearance in the circulation:

Is this because:

(1) One form disturbs the other? or

(2) Does quinine destroy *P. vivax* quicker than it disposes of *P. falciparum*?

We think not, for its administration preventively, effectively, and its administration curatively, in large doses, neither of which was done in 1916, would, in 1917 and 1918, have modified the proportions. Now this has not been the case. Moreover, there are mixed forms, where we find simultaneously *P. vivax* and *P. falciparum*.

We lay stress on the fact that these curves are true; they do not merely represent percentages more or less factitious.

[1] In these investigations as a whole we were aided by the work of Dr. Casenave (Algeria), Dr. Carabinas (Greece), Dr. Dziffras (Greece), Dr. Magallon (Martinique), Dr. Guérard (Colonial Army), Dr. Scheniot (Russia), Dr. Karlinsky (Russia), Dr. Nattanson (Poland) and Mr. Noel Nougat, hospital attendant.

[1] The original Gradobor curve gives them, of course, day by day, but, for typographical reasons, that original could not be reproduced here in its entirety.

If the 1917 and 1918 curves are higher, it is perhaps because the paludism was more severe (yet all the cases examined were treated therapeutically with heavy doses according to official prescriptions); but especially is it because there were then many more soldiers in Macedonia than during the first-named year.

Therefore, some general cause, other than individual resistance, other than the treatment, and other than the mutual antagonism of the forms of parasite, must be held to govern this alternation of species.

This cause is the medium, the external temperature. This is the vital factor.

In analysing Chart I we find that:

(1) *P. vivax always appears when the temperature is near zero (Centigrade) with considerable variations during the day (1917 and 1918 February-March) in relation to the rainfall. It is most prevalent when the lowest temperatures of the day are about 5° C., from which time it diminishes progressively.*

(2) *P. falciparum always appears when the minimum temperature reaches from 25° C. to 30° C., after which time its frequency increases in spite of the progressive fall in the temperature towards zero. Between 5° C. and 0° C. it begins to decrease and P. vivax reappears.*

(3) *During the period of rising temperature, between 5° C. and 25° C., eastern paludism, whether in vivax or falciparum form, is in the latent stage.*

(4) *Assuredly there are mixed forms. These have the drawback of displaying the symptoms in winter and in summer and autumn.*

Two other features are brought out by the examination of these curves.

(1) *P. vivax makes its appearance in the wet season.*

(2) *P. falciparum turns up in the dry season,* so long as the minimum temperature has not gone beyond from five to ten degrees.

Why does *P. falciparum* continue coming forth during the period of falling temperature (we are dealing all the time with "quinined" cases) when it does not do so during the corresponding upward trend of the thermometer?

This phenomenon is due to the fact that a high temperature is necessary for the appearance of gametocytes in the blood, i.e., to start the reproductive stage, which lasts until the external temperature has again reached 5° C. At this point a reproduction seems no longer possible.

Now since the war, we have, in all the malaria patients observed by us, verified this fundamental law: that the onset of both vivax and falciparum attacks depends chiefly on the temperature of the air.

Recapitulation.

(1) *All the patients to whom this curve relates were treated in hospitals in the officially prescribed manner, with as much as three grammes of quinine daily. The absorption of the drug was closely watched, and most of the cases were treated by injections.*

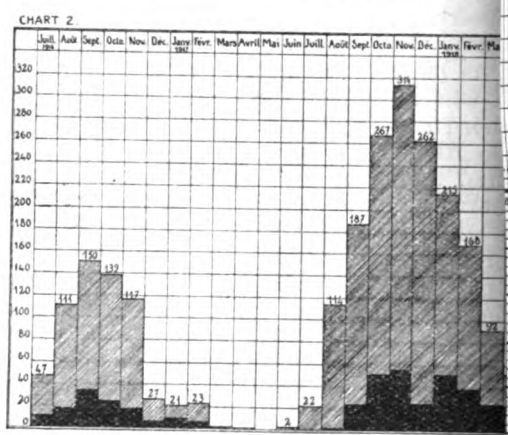
(2) *The advent of real attacks is periodic and dependent upon the outsid ture and meteorological conditions in ge*

(3) *The onset of P. vivax is determine peratures reaching about zero, and conti the thermometer rises, so long as it d beyond from 5° C. to 10° C.*

(4) *The falciparum outbreak only begin minimum temperature reaches between 2 30°C., and it lasts, in spite of the ther progressive fall, until a temperature of a is again reached.*

PROPORTION OF GAMETES AND SCHIZ THE BLOOD.

Chart II relates exclusively to the pr numbers of gametes (full-grown forms) an



(young forms) of *P. falciparum* found in th ing blood of patients under treatment. O that:

(1) *The gametes appear when the outside ture is about 25° C. (see July, 1916, 1917 a*

(2) *The schizonts (sexual reproduction appear before the gametes and during the preceding the arrival of minimum temper 25° C.*

Only these latter are found in the ci blood during attacks; *therefore it is certa coming of the gametes which governs t swarming of falciparum, which lasts into N and December.*

The schizonts appearing before the ga the circulating blood, and surviving them, proof that production *begins in the tissu* temperature below 25° C., and that afterw gametes leave there and continue reproducin circulating blood, only disappearing at the the period of attacks.

Further on we shall return to the the importance of this phenomenon. For the we confine ourselves to pointing out that i case where many gametes are found in th the curative effect of quinine is practica *Thus the drug would appear to act upon th ductive capacities of the gametes only whe are still in the tissues.*

vier 1918 Février

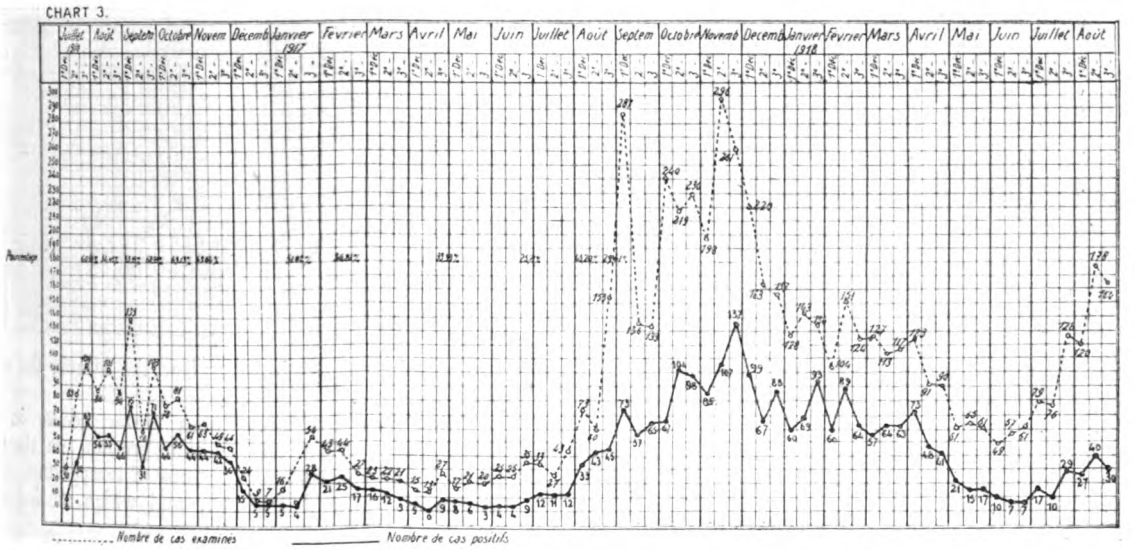
Recapitulation.

The schizonts appear in the blood before the gametes. (This was so in every case treated.) The latter never attain, in the circulating blood, a higher portion to the schizonts than one to six.

Lastly, the maximum of gametes corresponds to the maximum of schizonts.

Cases of Clinical Paludism in which the Blood Examination was Negative.

Chart III shows how very often, in cases treated with quinine and suffering from attacks, the examination of the blood gave a negative result.



On the other hand, there are many patients who, clinically, appear to have malaria, but who are not parasite carriers in their peripheral circulation.

The dotted curve indicates the total number of sufferers from clinical paludism.

The full curve shows the patients the examination of whose blood gave a positive result.

We find:

(1) *A similarity between the two curves, marking the close clinical connection between the cases with positive blood and those with negative blood.*

(2) *The percentage of cases with negative blood is especially high in the periods of severe febrile attacks.*

(3) *These periods are necessarily the ones during which the patients are given quinine in the strongest doses.*

We can, therefore, conclude that quinine, while not warding off attacks of fever, does lessen the chances of carrying the parasites by mosquitoes.

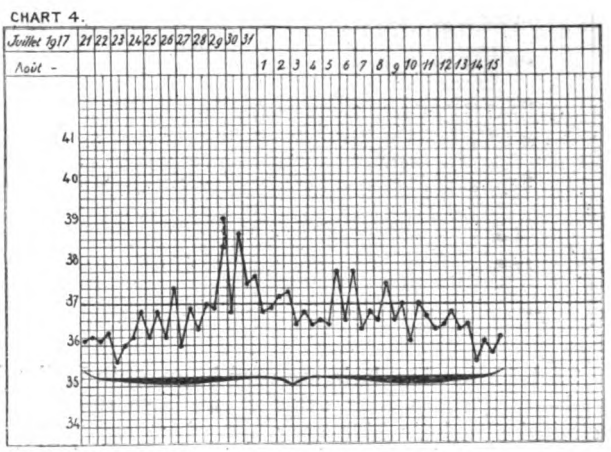
Special Study of the Thermal Curve in Malaria Cases.

The purpose of the following analysis is to show that a paludal attack does not consist of a rise of temperature by one or more steeples over 37° C., but, *in every instance*, of a number of oscillations (which often begin at 35·5° C.) extending over fifteen or twenty days, the return to normal only taking place after this length of time.

Let us take Chart IV (*falciparum*) as an example. The patient showed uneasiness on July 21, and had a rectal temperature of 36° C., but the real attack was not actually observed until the 29th.

Now in ordinary language one may say that the attack ended August 1, whereas, on the contrary, in spite of the quinine taken, two steeple jumps occurred, on September 5 and 6, and final stability of temperature only came on September 14 and 15, viz.: at about thirty-six degrees. (Rectal temperatures are not to be always understood.)

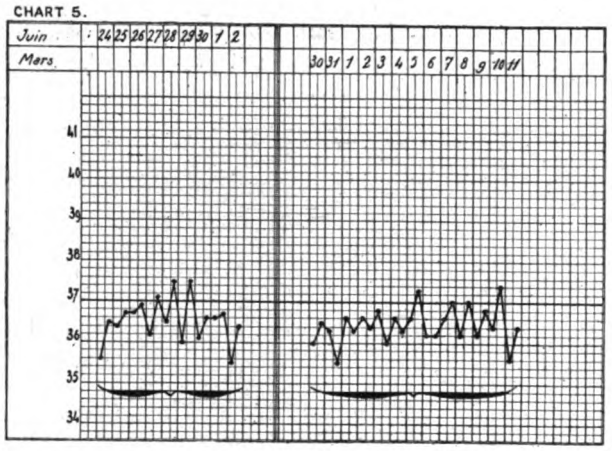
From a practical and clinical standpoint, there was, therefore, one attack lasting twenty-three days,



and not two separate attacks, on the 29th and 30th and on the 5th and 6th, as is the general assumption.

Chart V gives two examples tending to prove the above phenomenon. Both patients are *falciparum* carriers, and in both cases the rectal temperature has never exceeded 37·5° C. It is to be noted that we are not here in the *falciparum* multiplying period, that the patients show a clinical state of fever, and that their temperature oscillates to the extent of 1·5° C. above 36° C. for nine days in one case, and thirteen in the other, which, in spite of

CHART 5.

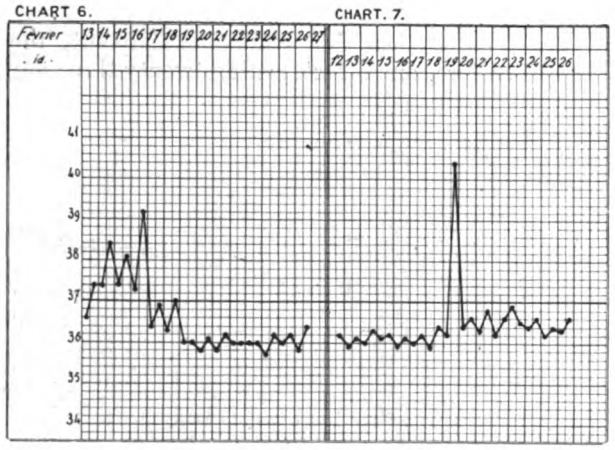


the absence of jumps, amounts to actual attacks of long duration, to be considered and treated as such.

Attacks of this kind are nearly always unrecognized clinically, as they take place in cases considered cured.

Yet these cases, having parasites in their blood, are naturally contagious.

CHART 6. CHART. 7.



Such forms of malaria are very frequent in Holland.

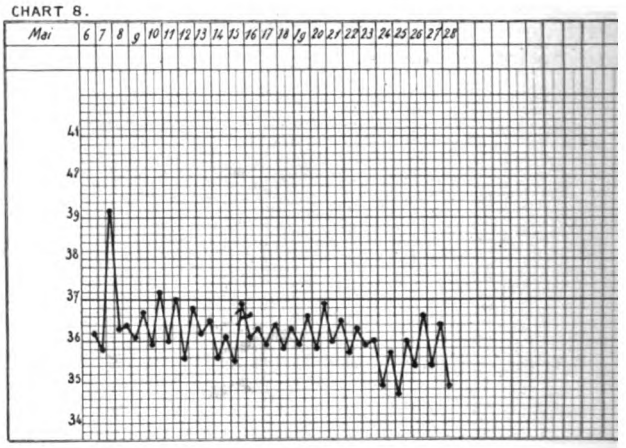
Besides these long attacks, we also meet with clinical attacks, which are much shorter.

However, they are characteristic of *P. vivax* infection. This infection, moreover, presents the features shown in Chart VII. *The vivax attack is strong and sudden*, the temperature rising above 40° C. in a few hours, and falling again to normal in the next few hours; but what denotes the presence of pure *vivax* is the steadiness of th thermal curve before and after the attack, whic period of stationary temperature, prior to an following the febrile crisis, we will call the "*calm vivacien.*"

Vivacian Steadiness.

Chart VI, which is much more fluctuating because it is a matter of double infection (*viva*

CHART 8.

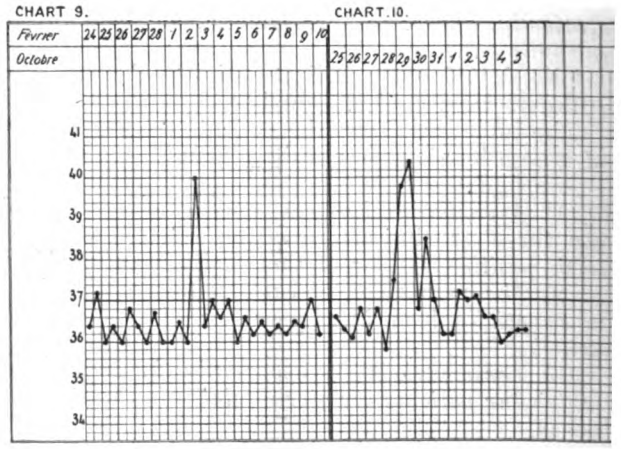


and *falciparum*) shows, after the attack, the same phenomenon.

This thermal steadiness never occurs in the *falciparum* infections, which present, on the contrary, characteristic variations of temperature, going at times beyond 1·5° C., and which are indicated in Chart VIII.

This we will term "*l'inquiétude falciparique,*"

CHART 9. CHART. 10.



Falciparical Unrest.

The diagnosis to distinguish between falciparum infection and that due to vivax can, consequently, be made clinically by means of the thermal curve, even in those periods when the blood examination is negative.

In double infections, where we find *falciparum* and *vivax* schizonts together, the curve has shapes which we will call "cathedral shapes," in which we

clearly decipher the sudden vivacian attack overriding the falciparical uneasiness which both precedes and follows it. (Charts IX and X.)

These details are still better understood if the patient's temperature is taken hourly, day and night, and the blood examined every two hours.

Chart XI reproduces the hourly progress of a *P. vivax* attack. It will be noticed how rapid is its advance from 11 a.m. to 8 p.m., succeeded by the "calme vivacien" during the next twenty-four hours, and that, despite the constant presence of schizonts in the blood.

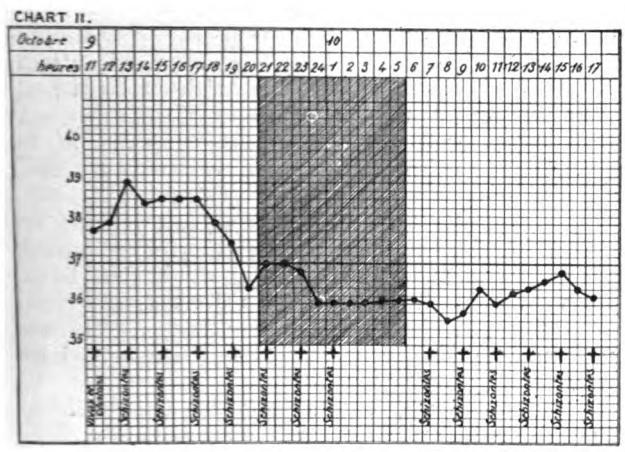


Chart XII shows, on the other hand, the hourly progress of a *P. falciparum* attack.

The blood was examined hour by hour. It will be noticed that the attack lasted two days and two nights, that the temperature rose by irregular oscillations (falciparical uneasiness), and that in the next twenty-six hours—between 4 p.m. on September 10 and 6 p.m. on the 11th—there was a difference of 1 to ½ degrees. It should be noted that the blood examination throughout this attack was now positive, now negative, notwithstanding the severity of the treatment.

To elucidate the reasons for the "*calme vivacien*" "*l'inquiétude falciparique*," hourly examinations of the blood were made during the forty-eight hours following an attack.

Chart XIII covers the period succeeding a pure *vivax* attack. One sees that the temperature has kept below 37° C., with slight and regular oscillations, despite the constant presence of young *vivax* forms in the blood. Near the end of the curve it is seen that the number of negative examinations increases.

Therefore, the manifestation of the schizonts lasts longer than the attack, and is not the sole factor determining the same, as is generally believed.

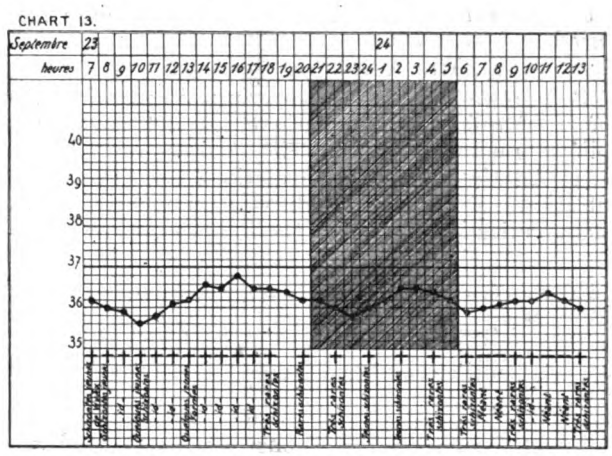
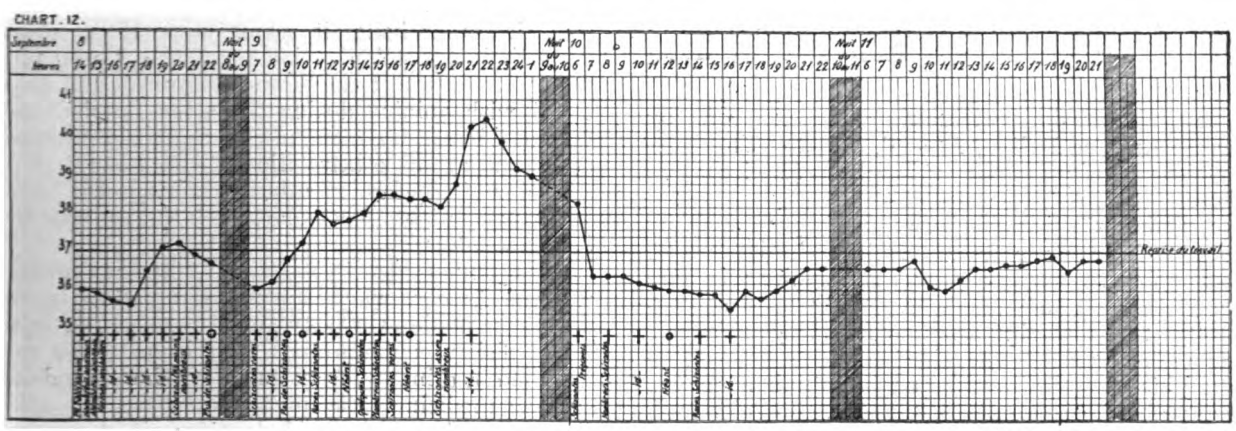


Chart XIV is a sign of the disturbance following a *falciparum* attack. Up to and over 37° C., the temperature oscillates through a range of 2° C. This patient is cured, "clinically" speaking, and yet he has gametes and schizonts in his blood.



Recapitulation.

(1) *The vivax attack is sharp and short; it is preceded and followed by a pause, the "vivacian steadiness" ("calme vivacien").*

(2) *The falciparum attack, on the contrary, approaches gradually, and its acme is lower than that of the vivax attack It is preceded and followed by a series of thermal oscillations of as much as*

2° *C., which constitutes the "falciparical unrest"* (*"l'inquiétude falciparique"*).

This acme may fall short of temperatures regarded as febrile, and the entire attack, which may last as long as thirty days, begins and ceases with the "falciparical unrest." It may be marked down entirely between 35 *C. and* 37·5 *C.*

(3) *The presence of schizonts in the circulating blood is not in direct relation to the patient's temperature. They are also met with in attacks accompanied by a sub-normal temperature.*

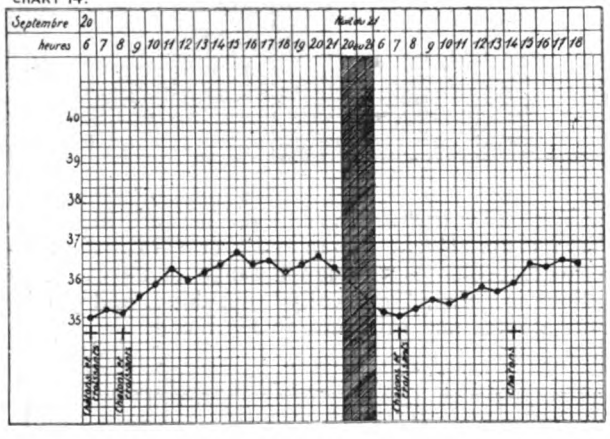
(4) *It is wrong to conclude that a sufferer whose temperature does not exceed* 37·5 *C. has not or no more, an attack, and it is unwise to consider him cured.*

THE ACTION OF QUININE.

Before we discuss the drawings illustrating the effect of quinine on malaria cases, let us fix the following points:

(1) All the rules and regulations for the administration of quinine, whether preventively or therapeutically, were strictly followed, as was repeatedly verified, particularly at Gradobor, by Messrs. Armand Delille, Abrami, Wisbek (Physician in Chief and Head of the anti-Malaria Mission), and others.

CHART 14.



(*a*) Quinine in solution was given preventively by the mouth in daily doses of fifty centigrammes. Every morning for two years A. Pagnier was present at the call and witnessed the thorough absorption of the medicine in the following manner: each man advanced when his name was called, received his spoonful, swallowed it and then opened his mouth. No man was exempted. Pagnier himself took the same dose of quinine. *Result: all the men, without exception, as well as the head physician, contracted malaria.*

(*b*) The sufferers from paludism either swallowed their quinine as above or had intramuscular injections.

The following curves give, therefore, an exact idea of the real effect of quinine upon malaria development in patients who remained in the district where they caught the disease.

In this connection, two points must be emphasized, viz.:

(1) *It is impossible usefully to study the effect of quinine upon patients who have gone from the place of infection to their own country, because the factors of temperature and climate come in and there is risk of crediting the quinine with recoveries due to atmospheric temperature.*

On this account, conclusions such as Ravaut's must be accepted with caution, seeing that such and such a patient who, in the East, notwithstanding the treatment, had subintrant attacks because, according to the form of infection, it was either winter or the æstivo-autumnal period, might, on his return to France, seem to react admirably to the quinine given "*lege artis*," whereas his attacks would probably have disappeared without treatment.

(2) We repeat that in spite of normal or subnormal temperatures the patient may be in the attack stage, and that, therefore, *temperature alone is no criterion of the efficiency of quinine.*

(3) Moreover, quinine is itself an antipyretic, and so may mask, and not suppress, a febrile attack.

Having laid down these points, we hasten to say that we are far from wishing to deny that quinine has any effect. We only believe that, as the tracings indicate, its action has been wrongly interpreted and exaggerated.

In the first place, it is indisputable that although they all, without exception, contracted malaria, those of our patients who took quinine preventively had the disease in a comparatively mild form, whether the agent was *vivax* or whether it was *falciparum.*

Therefore, if, according to our experience, quinine does not prevent infection, it nevertheless does render the same less severe. Further on, we will try to explain this phenomenon.

On the other hand, it seems clear that quinine has a distinct specific action upon the young plasmodiæ, for, as Chart III shows, the number of cases treated with quinine during the attack periods and in whose blood no schizonts were found is much larger than at any other period of the year.

We now proceed to examine certain typical curves concerning patients who underwent the quinine test *therapeutically.*

Let us take Charts XV and XVI as an example.

In the former, where a double infection is concerned, we made every day an intra-muscular injection of eighty centigrammes of quinine. We were warranted in thinking, from and after the second day, that the medicine had cut the attack. Nevertheless, we continued the said dose for six days, and, though the temperature had dropped from 35·5° C., we added sixty centigrammes of quinine in tablet form. In spite of this extra dose, the temperature had risen again to 37·5° C. by the twelfth day, and in the interval the curve showed falciparial uneasiness.

In Chart XVI (*P. falciparum*) we administered the first day, on an attack at 39° C., two grammes by intra-muscular injection. Next day, when the

temperature was 40° C., we again injected two grammes. The third day the temperature was 41° C. and we gave only fifty centigrammes *per os*, and on the fourth day the temperature dropped abruptly to 36·5° C. We continued the fifty centigrammes for eleven days, and saw the temperature rise again about the eighth day as high as 38·5 C. by wide falciparical oscillations, falling back afterwards to normal.

CHART 15. CHART 16.

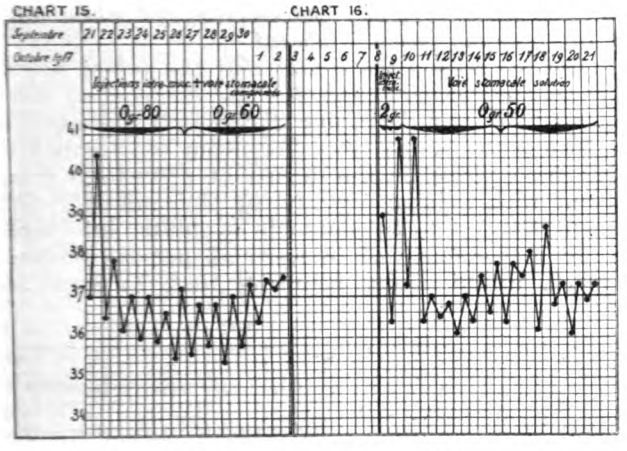
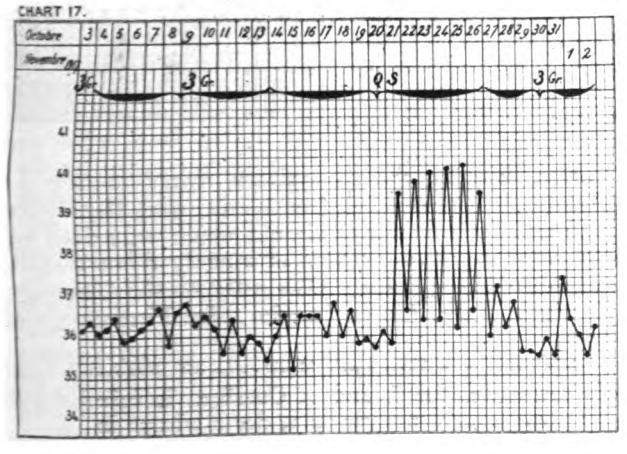


Chart XVII has to do with a patient who, from the 3rd to the 20th October, presented the oscillations characteristic of falciparical unrest. From the 3rd to the 13th, although there was clinically no attack, he received three grammes of quinine daily *per os* without there being any effect on the thermal curve. From the 14th to the 26th the quinine was

CHART 17.



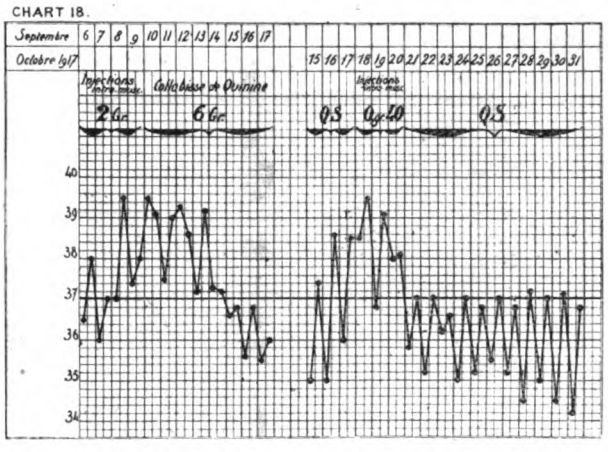
stopped. From the 21st to the 25th there was an attack every day at 40° C. The temperature fell of itself on the 27th without quinine. From that day the dose of three grammes was again given, and the curve returned to its previous shape.

Chart XVIII applies to two patients (*falciparum*). In the first case the patient received from the start of the attack three grammes of quinine per day by intra-muscular injections. On the fourth day of this treatment the temperature was still at 39·5° C. Then six grammes of "collobiase" of quinine were injected, and it was only on the fourth day that the temperature fell back below 37° C.

The second *falciparum* patient, notwithstanding his rising temperature, had no quinine for three days; then for three days he was given forty centigrammes by intra-muscular injections. The temperature remained between 38° C and 39·C. On the seventh day it had dropped to 35·8° C. The quinine was stopped entirely, and there were oscillations of 2·5° C., without 37° C. however ever being exceeded. (All the temperatures of our drawings were rectal, and they were checked.)

Chart XIX extends over a space of two months, during which quinine was administered in variable doses. For the first ten days and the last fifteen the patient had no quinine. In this time the curve moves about a good deal, much more than during the middle period, when he had doses (capsules or injections) varying from 1·20 gr. to two grammes, regardless of the thermal curve. Yet it is while

CHART 18.



two grammes of quinine was being taken that we see the strong attacks on September 20, 22 and 24 and October 13.

We remark that those attacks extended through the period which, in the matter of climate, was the worst of the year.

Recapitulation.

(1) *Preventive treatment with quinine does not ward off infection, but it does render it less severe.*

(2) *In a vivax and falciparum infection curative treatment with quinine does not seem to stop an attack from following its course.*

(3) *The chief curative effect of quinine is to destroy more or less completely the schizonts circulating in the blood, and thus make the attacks less dangerous in their clinical manifestations and the patients themselves less contagious.*

CONCLUSIONS.

We deem ourselves justified in drawing from our investigations the following practical inferences:—

(1) *Prophylaxis of Malaria.*

The common idea that malarial infection can be avoided by taking forty or fifty centigrammes regularly every day is certainly erroneous. *The constant absorption of quinine does not prevent infection.*

On the other hand, it seems certain that the forms of paludism met with in persons who have taken quinine as a caution are generally milder than in those subjects who, before becoming infected, did not take quinine.

Preventive treatment seems, therefore, to have an inhibitory influence over the virulence of the plasmodiæ, as well as on their vitality in general.

But it is quite unlikely that quinine in preventive doses can, as some authors have stated, fortify the body's natural resistance to paludal infection. Quinine, being theoretically poisonous to protoplasm, we might take the opposite to be the case.

Hence, it is idle to surmise whether heavier doses of quinine would bar infection, because they would not be tolerated for long, any more than would adequate doses of arseno-benzol, if given to prevent a syphilitic infection; and there would be the risk of lowering the natural resistance of the organism.

Resistance to malaria seems to be considerable in certain persons, just as it is to other infections. We know of many individuals who have lived in malaria-stricken countries without taking quinine as a preventive and yet have not been infected. *So the fact of having escaped malaria after such preventive action is no proof of the latter's efficacy.*

We cannot conclude in such a case that, without quinine, infection would not have been avoided just the same.

We will further say that most of the writers who believe in quinine and in preventive treatment ignore the importance of the algid, sub-normal or afebrile forms of paludism described above.

The absence of fever in the usual clinical meaning of the term does not prove that the subject is not suffering from malaria, and it is often these apparently afebrile forms, the nature of which is moreover masked by the quinine's purely anti-pyretic effect, that produce those severe cases of anæmia and cachexia of obscure origin which are only alleviated by a change of climate.

To sum up, we consider it logical to continue advocating preventive treatment with quinine; not, however, in the hope of warding off infection (which only inherent immunity can do), but to lessen the gravity of the type of paludism acquired when sufficient resisting power is absent.

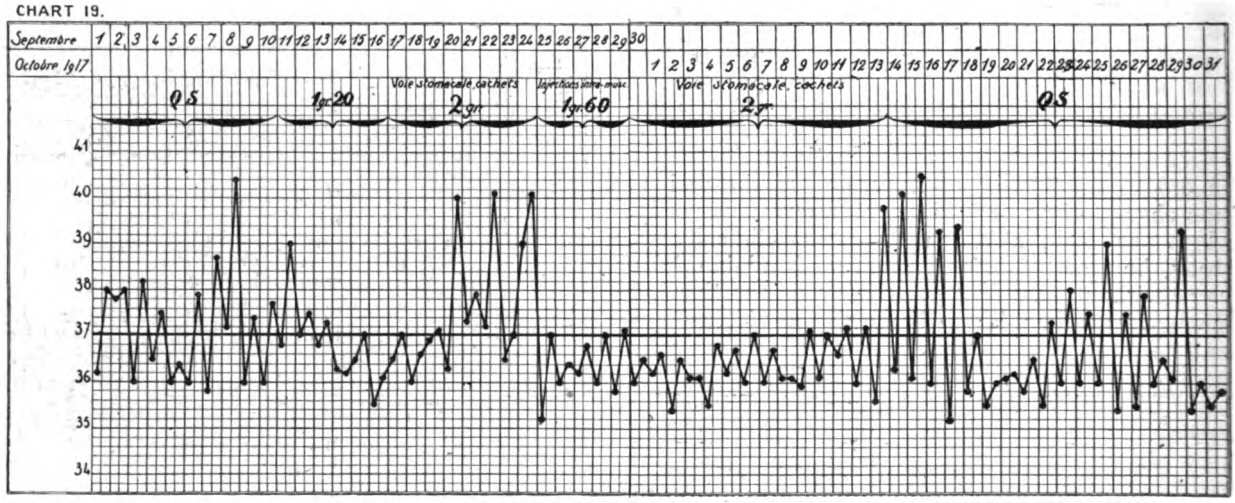
But we remind the reader that the surest means of escaping malarial infection lie in avoiding mosquito bites and destroying the insects themselves.

The truth is too often forgotten on account of the trust placed in the dogma of preventive treatment with quinine, exactly as Metchnikoff's ointment has led to innumerable syphilitic infections.

It is therefore well to warn all persons proceeding to malaria-ridden countries that, to avoid infection, keeping the mosquitoes away is more important than preventive treatment; and the Governments of such countries should wage organized warfare on mosquitoes, instead of merely recommending people to take quinine. (We refer to the Campagna, Southern Italy, Rio de Janeiro, the Panama Canal, &c.)

We may mention here that one of France's finest departments, the Island of Corsica, is infected with paludism and yet nothing is done about it.

CHART 19.



(2) *Therapeutics of Malaria.*

(*a*) *Abortive Treatment.*— Some authors, like Ravaut, admit that it is possible, by strong treatment with quinine, to arrest a malaria infection just as one can stop an attack of syphilis.

We find it difficult to understand on what this idea is based. We know neither the premonitory symptoms nor the length of the incubation in paludism, and we have no means of getting to know them.

The disease starts with a first attack, and although this attack is foreshadowed by certain prodromata, these only appear when the plasmodiæ have already penetrated deeply into the tissues, especially the spleen.

Thus it is impossible to compare the course of malarial infection with that of syphilis.

We can stop an attack of syphilis because, in the beginning, the infection is strictly local.

In malaria the infection is general at the first onset, and once the parasites circulate in the system and plant themselves in the tissues we can as little hope to exterminate them as we can so do with syphilis which has passed the primary stage. The abortive treatment of paludism is impossible theoretically, and in practice we find this confirmed.

The opinion of those authors who believe in abortive treatment must be founded on errors of interpretation. There may be two causes for these.

Firstly, one often sees very mild cases of paludism, especially in *vivax* infections; these are limited, even in untreated cases, to a few attacks, after which there appears to be a recovery. This may be really so sometimes, but in most instances a fresh attack comes sooner or later, proving the contrary.

Those slight sufferers had strong powers of resistance or were not infected with very virulent parasites.

We have met with the same features in many syphilitics.

Then, in other cases—and they are apparently the most numerous—one can admit the value of abortive treatment, because the patient has no fever and his malaria shows at once an aglid aspect. Such cases are nearly always due to *P. falciparum*, and occur not only in the Mediterranean Basin, but elsewhere as well, viz.: along the Rhine, Holland, Poland, Galicia, on the banks of the Volga and in certain provinces of Roumania, where one of us has specially studied them. These are subjects who have never had a temperature above 37·5° C., and yet have always—particularly in summer—had their malarial attacks, with plasmodiæ in their blood.

The conclusion is that abortive treatment of the disease is impracticable.

(*b*) *Treatment of declared Paludism.*—Basing our opinion on the observation of more than 6,000 malarial cases, both on the scene of the disease's development and after the patients' return to their own country, which observation has extended over upwards of ten years, we believe ourselves justified in affirming that a sufferer from paludism very rarely recovers, strictly speaking, and that while he may have no more attacks, he continues almost invariably, just as the syphilitic seems to do, to be a "germ carrier"; his gametes may remain dormant for longer or shorter periods, but under certain conditions they are capable of arousing swarms of schizonts and inducing new attacks.

Now our investigations show the main cause for the reproduction of plasmodiæ to be the variations of temperature of the air, and its degree of humidity.

The influence of these variations differs according to the species of plasmodiæ.

The P. vivax victim cannot stand cold weather, especially if it be wet at the same time.

The P. falciparum sufferer cannot bear hot weather.

A glance at Chart I, which, so far, is a document unique in the literature of the subject, suffices to bring conviction of the truth of this statement.

It follows that the vivax carrier must avoid temperatures lower than 5° C., and the falciparum carrier heat above 25° C. (Minimum temperatures in both cases.)

This, to our minds, is the chief thing in the therapeutics of clinical paludism. Lucky are those who can afford to act upon it!

The most unfortunate are those persons who are *doubly infected*, it being more difficult for them to find a suitable climate. They should select the mildest climates possible, or change their residence periodically, according to the time of year and their types of parasite.

Besides climatic influences, the other causes helping to induce an attack are of minor importance. They are, in general, those tending to reduce the body's resistance to any infection; bad hygienic conditions, intercurrent maladies, traumatic disorders, and so on. Their effect upon chronic malaria sufferers has long been known.

(3) *What is the part played by Quinine in the Treatment of Paludism?*

Quinine cannot cure: it merely mitigates, more or less, the clinical manifestations of the disease.

The drug seems to act most strongly upon the young plasmodium elements; that is to say, the schizonts. Apparently, it destroys many of these before they have been able to enter the red globules of the blood. Therefore, we can, thanks to quinine, restrict the number of cases of severe anæmia of pernicious types, and such dangerous manifestations as, for example, those due to miliary embolism of the brain.

But quinine seems to have no effect upon the full-grown forms, the gametes, especially when they are in the tissues and have not yet entered the circulating blood.

In attacks not treated with quinine we almost invariably find schizonts in the blood. On the other hand, in patients who take adequate doses of quinine we frequently note the absence of schizonts from the blood. This is the effect of the quinine. (*See* Chart No. 3.)

We may further deduce that the patient dosed with quinine during his attacks is less infectious than he who does not take the medicine. We are, therefore, obliged, in acute paludal cases, to administer quinine in sufficient quantity (two grammes *per os*, 0·6 to 0·8 gramme, by intra-muscular injections); but as soon as the patient's state admits we must endeavour to send him to a climate suited to his kind of infection, i.e.:

The vivax patient to a hot country,

The falciparum patient to a cold country.

Even in the worst cases of hæmoglobinuric paludism, it does not seem to us that there can be any contra-indication to the administration of quinine. Koch's opinion that hæmoglobinuria is caused by the quinine strikes us as unfounded, but, in this case, above all, the patient's prompt transfer to an appropriate climate is called for.

As to the use of quinine in chronic cases where the attacks are rare, we think there is little utility in it. It will suffice to administer the drug at the time of an attack, in order to kill the excess of schizonts. Taking quinine during the intervals between attacks has no effect upon the gametes in the tissues, and will not bar the new attack, which, *if the patient's natural resistance is insufficient*, the atmospheric temperature will bring on by arousing the dormant germs.

Definitely, the fate of the malarious person will hinge upon three factors:

(1) *His degree of relative immunity, which will vary according to his general state of health.*

(2) *The virulence of the "germ family" by which he was infected, which virulence will certainly weaken more or less in time, through advancing age and the natural defensive powers of the organism.*

(3) *Atmospheric conditions and climate, with reference to the species of infecting parasite.*

Our investigations have especially borne upon the *P. vivax* and *P. falciparum* types of malaria. We have had but little experience of the *P. malariæ* forms, and hence we abstain from formulating any conclusion thereupon. The small number of cases observed by us showed distinctly periodical onsets, at least in the beginning, so that one could often predict the day and hour of the next attack.

In these cases it seems possible to moderate to some extent the clinical gravity of the attacks by administering a proper dose of quinine a few hours before.

This possibility does not exist, however, when it is a *vivax* or a *falciparum* case, in which the attacks, even from the start, are nearly always extremely irregular.

DENGUE *v.* MALARIA.

By R. E. Ingram-Johnson, L.R.C.P.Ed., &c.
Labu, Negri Sembilan, F.M.S.

Regarding malaria as almost, if not quite, the disease of most importance to humanity, both owing to its effects on those suffering from it, and its world-wide incidence, the question arises as to what is the best way to deal with it. Since the discovery that it is mosquito-borne, wonderful work has been done in the fight against its carrier, with the effect of clearing vast areas and rendering them habitable, but it is absolutely impossible to eliminate entirely the Anophelene mosquito from areas just outside those under anti-malarial treatment. So long as these conditions obtain, and so long as there are any human beings with parasites in their blood within reach of the mosquito, malaria will exist, and, until the whole inhabited world is cleared, in tropical and temperate climates, these measures are only palliative.

Again, quinine, though it puts a stop to an actual attack of malaria, and when taken continuously may act as a prophylactic against infection, does not prevent a second infection soon after its administration is stopped.

The objective that, to my mind, is the one which one should try to attain, is the discovery of some agent which will not only destroy the malaria parasite actually present in the circulation, but will also produce a condition in the blood of persons employing it, which prevents the proliferation of the parasite when introduced into the circulation by infected anophelenes. The attainment of this objective means that the human body eventually ceases to act as a host of the parasite, and hence infected anopheles die out, leaving the remainder as irritating but not poisonous-carrying insects. It is with this idea that I bring forward my theory of "dengué *versus* malaria."

In my two previous papers on this subject, published in the Journal of May 1, 1922, and January 15, 1923, I endeavoured to show that an attack of dengué fever has the peculiar property of causing immunity from infection by the malaria parasite, and also of preventing a recurrence of malaria in persons previously affected. I also propounded the theory that dengué is a modification of malaria brought about by a degeneration of the malaria parasite after its ingestion by the dengué-carrying mosquitoes, *Culex fatigans* and *Stegomyia fasciata*, or *calopus*.

It is objected that dengué is caused by a blood spirochæte, as spirochætes have been found in the blood of dengué patients. Against that idea is the fact that serum obtained from the blood of a dengué patient, filtered through the finest possible filter and examined microscopically without any organisms being visible, has caused dengué after injection into the bodies of healthy persons, thus showing that the spirochæte is not necessary to produce dengué. That being the case, is it not more than possible that the spirochæte form is an intermediate stage in the degeneration of the protozoan malaria parasite, which ultimately results in the formation of the ultra-microscopic dengué germ? This dengué germ produces fever of a somewhat similar type to that of malaria, to saddle-back temperature, but instead of going on proliferating and causing high temperatures every forty-eight or seventy-two hours, its first struggle towards reproduction, shown by the second rise of temperature, ends in its death, and the probable formation of an anti-toxin, which does not protect against dengué itself, as a second attack may speedily follow the first, but, as I hope to be able to show, acts against the malaria parasite, the *fons et origo mali*.

In my former papers I produced evidence of persons who, having themselves suffered from malaria, contracted dengué and thereafter, though living

under the same conditions, had no more attacks of malaria, and other persons who, having had an attack of dengué, were later exposed to infection in malarious districts and remained immune. These cases were too numerous to be classed as coincidences, so I suggested that a " serum " could be made from the blood of persons recovering from dengué which should have a prophylactic and a curative effect against malaria.

Acting on this idea, I tried, whilst in Colombo, to find a case of true dengué from whom to obtain some blood for experiment. By *true* dengué I mean a case conforming to the following course of events: (*i*) saddle-back temperature; (*ii*) initial roseolar; (*iii*) secondary rubeolar eruption on hands and forearms, coinciding with the terminal pyrexia; (*iv*) severe pains in fingers, hands and wrists. I was unsuccessful there, so migrated to Rangoon, with no better result. Believing that there would be better opportunities of studying both diseases in Malaya if I could secure some estate work, where there are numerous hospitals for coolies, I came here in February, 1924. I found many cases of so-called dengué, but at last succeeded in getting hold of three cases such as I wanted, and obtained some blood from them. This I took to the Institute of Medical Research, Kuala Lumpur, where I was very kindly received by the staff, who collected the serum, examined and prepared it, and certified it sterile. Having obtained the serum, I proceeded to try its effect on four persons suffering from acute attacks of malaria, and also on two other cases on the same estate who were in hospital suffering from injuries, both as controls and also with the idea that the serum (or vaccine) would act as a prophylactic. At this time there was a virulent outbreak of malaria on the estate, the subsoil drainage system having broken down and adult *Anopheles maculatus* being commonly found in the hospital itself. Firstly I ascertained that the six cases had had no treatment for malaria and then gave instructions that no other treatment than the vaccine should be given, and gave 1 c.c. intramuscularly to each person. All but one case had a second dose of 1 c.c. after seven days. In this one case after the first dose the temperature went down rapidly and stayed down for eight days, so that I believed that one dose was sufficient, as all parasites had disappeared. However, on the night of the eighth day the temperature rose to 102° F., so the following morning I gave a second injection, as a few parasites had reappeared. The temperature in this case rose nightly and was down in the mornings, so as the vaccine was only in the experimental stage, I thought it better to give a dose of quinine, so I gave one single dose of ten grains on the fifteenth night, after which every sign and symptom of malaria disappeared. As the temperature had been hectic in its character for seven days, it seemed to me remarkable that one small dose of quinine should have such a striking effect, so I felt justified in concluding that the amount of vaccine administered had not been sufficient to destroy the numerous parasites present in the circulation, and that probably one more dose of the vaccine would have had the same effect. In two other cases, after an initial fall of temperature for a day or two, there was a nightly rise of temperature and a morning fall, gradually dying away to normal without any other treatment.

In the fourth case there was a gradual defervescence of temperature and disappearance of parasites.

The two cases of injury who were treated with injections, though sleeping in hospital without mosquito nets for three weeks, and then going back to the lines have remained free from infection, and are among the very few coolies who escaped out of between 200 and 300 coolies on the estate.

I also experimented on two persons who, for seven or eight months, had had attacks of malaria (with parasites visible) at regular intervals of four weeks.

One of these was the European manager of an estate, who offered himself for experiment, the other being a coolie. After their last attack of malaria, five months ago, it was arranged that neither of them should take any quinine or medicine of any kind, and that they should have an injection a few days before the date on which the next attack was expected. I prepared blood films from both cases just before the injection and found parasites present in both cases. Three or four days after the injection, both were perfectly well and blood films were free from parasites. Seven days after the first injection blood films showed a few scattered chromatin dots only and a second injection was given. Since that time up to date neither of them has had any fever, and blood films taken at intervals of a few days prove absolutely negative, all the red cells being perfectly normal.

The above cases, I am well aware, are not sufficient in number to be accepted as positive proof of either the cure of malaria or its prevention, but the next series of experiments I made, I have confidence in stating, do actually prove that the blood serum I obtained is truly a vaccine, which differs from the vaccine against typhoid inasmuch as it is formed by the natural death of the dengué germs in the human body, whereas the latter is prepared from cultivated *B. typhosus* artificially killed. Secondly, that this vaccine has a destructive action upon the the malaria parasite.

These later experiments are some that I have made on children with greatly enlarged spleens. As splenomegaly in these cases is caused by the presence of multitudes of living parasites in the spleen, and as the enlargement remains so long as they *are* present, it is not begging the question to argue that if they are destroyed and absorbed, the spleen itself, if it has not already become fibrous, should diminish in size, and conversely if the spleen *does* become smaller, it is practically a proof that the parasite has been destroyed and absorbed. I am aware that people have left the tropics with enlarged spleens which have undergone considerable shrinkage after a residence in temperate climates. I also know that even in tropical climates enlargement of the spleen has been considerably reduced by appropriate treat-

ment after many months, but the majority of cases remaining in the same place show practically no diminution, even under regular and continuous treatment. All cases in which the enlargement has disappeared are cases in which the disease causing the splenomegaly has disappeared also.

It struck me, therefore, that if this vaccine has the power of destroying the malaria parasite, or at any rate of preventing its proliferation, the surest proof, and one practically incontrovertible, would be to try its effect on these chronically enlarged spleens in children, in the hope that, if fibrosis had not already set in, and that the vaccine had the effect I expected, these spleens would begin to diminish in size just as soon as the irritation of the presence of living parasites was removed. I therefore selected three boys, aged respectively five, eight and thirteen years, with enormously enlarged spleens. I first stopped all treatment and then gave each of them 1 c.c. of the vaccine intramuscularly, having marked out the area of enlargement with silver nitrate, so as to have a fairly permanent outline. There was no febrile or other apparent reaction after the injection. On examination a week later, I found a distinct shrinkage, both vertically and laterally, and I gave them each a second dose. At the end of the second week I found a still further shrinkage and I left them for another seven days before giving a third dose, when I found a still further diminution in size.

I think I am safe in saying that no such rapid shrinking has taken place previously, under any form of treatment in cases of chronic splenomegaly though in acute splenitis, which these cases certainly are not, enlarged spleens have rapidly diminished in size as the inflammatory conditions have subsided.

As controls, I have watched other similar cases, living under exactly the same conditions and having the usual treatment with quinine, iron and arsenic, without the slightest change having taken place. I feel justified in claiming that these results are due to the destruction of the malaria parasites in the spleens of these children. That being so, the vaccine being obtained from the blood-serum of patients known to have suffered from dengué, and being certified free from all visible organisms, and having an effect on the malaria parasite such as no other known form of treatment can produce, surely proves that there is a distinct connection between the infections of malaria and dengué, as certainly as there is a connection between the infections of varicella and variola.

Again, as the vaccine has such an effect on living parasites already in the blood cells, one may reasonably conclude that its introduction into the circulation, before a chance of infection has arisen, will prevent the maturation of sporozoites introduced by infected anophelines, and hence it is a true prophylactic against malaria.

As regards its curative power against acute attacks of malaria, I have not yet been able to secure a sufficient quantity of the vaccine to make a lengthy series of experiments, but I am convinced that it has the power of destroying the parasite in its quiescent state, and of preventing its proliferation, therefore, I see no reason why it should not destroy the parasite speedily when in an active state, if it be administered in larger and more frequent doses.

CONDITIONS OF MEDICAL WORK IN A WEST AFRICAN BUSH STATION.

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Very little, I think, is known to others than the men actually there of the nature and duties of a medical man in the average bush or out-station in British West Africa; away from the modern adjuncts and conveniences of our profession, where frequently bricks have to be made without straw. This was brought home to me by the questions of my old hospital colleagues whom I met when I was last on leave in England, in 1922, after nine years' consecutive work in West Africa. A little more is known about work in the large coast towns, with their well-equipped hospitals, sanitary departments and research laboratories, from the occasional papers that emanate from them.

My excuse for this article on Bo, a bush station in the Protectorate of Sierra Leone, is the hope that it will be of interest to medical men practising in England, to those considering working in the tropics, and to those who, working in another part of the tropics, would like to know conditions in regions they are unfamiliar with. After eleven years' work out here, mostly in bush stations, I can write from personal experience.

W. A. Young, in 1919, published an article in the Journal of Tropical Medicine and Hygiene (vol. xxii, p. 9), in which he showed the extent to which diseases ordinarily met in any out-patient department in England were found here in Sierra Leone. He based his article on the statistics of the Colonial Hospital, Freetown, the capital. I am going to show briefly all the types of diseases, both those peculiar to the tropics and those also occurring in temperate zones, and all the other duties of a medical man.

For the purpose of this paper I am taking the cases that I have seen during the last seven months—September, 1923 to March, 1924—as typical of any similar period. Seven months ago I was transferred to this district and began to keep a record for this purpose.

But before getting on to the diseases I must give a short account of the country and the people.

Bo Medical Station is situated at the western end of the Kennema District of the Central Province of the Sierra Leone Protectorate. The Kennema District lies between long. 10° W. and long. 11° 55" W., and lat. 70° 36" W. and lat. 8° 34" W., approximately. According to the last census—1921—the area is 2,100 square miles with a population of 168,526. The country consists of rolling downs with ranges of hills in the northern parts. It is like all the Protectorate, very well watered, and is covered with the usual thick tropical bush. It is traversed from west to east by

the railway dividing it into two unequal parts, of which the northern is the larger. All the large communities and important towns are on the railway line, such as Bo, Gerihun, Blama, Kennema and Hangha. Kennema is the Administrative Headquarters and has a branch dispensary. Most of the medical officer's work is on the railway line, it is very rare for him to have to go off it.

The People.

The indigenous people are the Mendis, a typical negro race, short, sturdy and cheerful people, very virile, as shown by the fact that the use of the Mendi language is fast spreading among the adjacent tribes. Along with the Mendis you find:—

(*a*) I.—Members of the adjacent tribes, pagan, Konnoh, Timnee, Kissi, Lokkoh, Sherbro.

II.—Members of the Mohammedan tribes from the north, Susu, Fulah, Korankoh, Mandingo.

(*b*) Inhabitants of the Colony proper, or Creoles. These Creoles are a race in the process of fusion and consist of the descendants of slaves from the whole of the West Coast of Africa who were taken to America and the West Indies in the days of the slave trade. The immediate ancestors of the present Creoles came from Nova Scotia, England, the West Indies, and all the coast of West Africa. They were placed on the peninsula of Sierra Leone and provided for by the generosity of Granville Sharpe, Wilberforce, Macaulay, and the other abolitionists of the eighteenth century. Missionaries soon came among them and they have been a civilized and literate and educated people for two or three generations. They understand and appreciate the benefits of modern medicine and are on a higher developmental plane than the Mendis and other tribes.

(*c*) *Asiatics.*—Syrians from Beyrout, and Indians.

(*d*) *Europeans.*—From the British Isles, France and Switzerland.—In other districts many American missionaries are found.

According to the Census of 1921, out of 168,526 inhabitants, 995 are foreigners to the Protectorate. Of these:—

Creoles are	828
Syrians ,, ...	113
Indians ,, ...	7
Europeans ,, ...	38
Miscellaneous	8

The indigenous tribes are mainly engaged in agriculture and preparing produce—palm oil and kernels, &c., for sale, and supply the unskilled labour. The Creoles supply the mechanics and artisans, and smaller traders and Government clerks. The Europeans conduct the large business firms and the senior official posts, and a few are missionaries. There were five European ladies in the district during this period.

Climate.

There are two seasons; dry from October to April, wet from May to September. From December to February, at the time of the N.E. trades, a persistent dry wind called the Harmattan blows. Owing to the great evaporation that accompanies it there is a marked lowering of the temperature at this time. The following metereological particulars from the observation taken at Bo for 1923 will be of interest:—

Maximum shade temperature ..	98° F.
Minimum ,, ,, ..	60° F.
Greatest daily range of temperature	34°
Smallest ,, ,, ,,	9°
Total rainfall for the year	106·41 in.
Greatest amount on one day	3·96 ,,
Wettest month—July with	19·59 ,,

Communications.

Most of the important towns are on the railway. There are motorable roads for cars and lorries or motor cycles in the following places:—

Bo.—Twenty-five miles to south and twenty-eight miles to north.

Blama.—Twenty-four to north. Twenty-one miles along the line through Kennema to Hangha.

Hangha.—Twenty miles to Panguma, away from the line. Away from these roads and the railway the usual means of transport is by hammocks supported on the heads of four men. Horses do not thrive and are rarely seen here. The energetic can go on most bush roads and native roads on a bicycle, with frequent stoppings to get over small irregular rough stick bridges. The large rivers in this district are not navigable and so there is no river transport. The greater part of the travelling to be done is done by the railway.

Medical Personnel—Staff and Buildings.

At the present time in this and other Protectorate Districts where there is a Government Medical Officer there is no scope for a private practitioner, as the mass of the people do not yet sufficiently appreciate modern medical methods and the foreign element is not large enough to support a doctor adequately. All Government Medical Officers, however, except the Heads of the West African Medical Staff and the Sanitary Service, are allowed private practice.

There are two classes of medical officers employed under the Government: members of the West African Medical Staff (of pure European descent) and African Medical Officers (of West African or mixed West African and European descent). These two classes have received the same training and hold the same qualifications and degrees obtained and registered in the United Kingdom, and individual members relieve each other at out-stations as occasion arises. The main difference is that the West African Medical Staff receive better conditions of service and hold all the higher posts.

Staff.—In addition to the Government Medical Officer—who is without rival in his district and the last word on any medical or sanitary point, and who is looked up to by the populace as the only person who can order about the great District Commissioner, under certain conditions—there is a dispenser who is also a trained nurse. The dispensers are trained at the Colonial Hospital, Freetown, for five to six years before being sent out. Then there is a sanitary inspector who is also the vaccinator. The dispenser is assisted by one hospital labourer, and the sanitary inspector has two sanitary gangs. At Kennema there is a branch dispensary with one dispenser and one hospital labourer. No nursing staff is provided for

the hospitals, all serious cases being sent down by train to the Colonial Hospital, Freetown.

Quarters, &c.—In bush or out-stations the quarters provided for medical officers vary from a mud-walled thatched native house to the latest in concrete block bungalows. Similarly with the dispensers' quarters, on a less pretentious scale, of course. In this station the medical officer has a rather dilapidated wooden bungalow, which was formerly a temporary railway construction bungalow. Next door to the medical officer's bungalow is the dispensary, another wooden bungalow, the former railway construction club house; it consists of two rooms, a dispensary, an office and consulting room in one. A little way off is the dispenser's house, a native house, and near by is the hospital building—a single-roomed native house with no beds or any suitable furniture. Near the dispensary is a small mortuary, a hut with palm leaf walls and roof. There is also stationed here a railway ambulance coach—a converted covered goods wagon.

At the branch dispensary at Kennema there is the usual dispenser's house and a single-room dispensary. The medical officer occupies the Rest House on his visits. My predecessor acquired an old disused stone building, a former office, and had it adapted to a small hospital with one ward of four beds and a small office. This has been equipped with iron beds and bedding and a sink with a tap has just been installed. Only those who have had to work for years without it can appreciate the luxury of a pipe-borne water supply inside the premises.

The dispensaries are equipped with the usual stock of drugs and dispensary adjuncts. There is a portable metal operating table and the usual minor surgery instruments with chloroform mark and drop-bottle. Chloroform is the only general anæsthetic used here. There is a good Zeiss microscope with $\frac{1}{12}$, $\frac{1}{6}$, $\frac{2}{3}$ objectives, mechanical stage and condenser, &c., also slides, cover-slips and the commoner stains.

Duties of the Medical Officer.

The first charge, I take it, of the medical officer is the care of the Government officials, then the general populace who attend the dispensary, and lastly, his private patients. He has to deal with any of the usual or unusual cases that may occur—medical, surgical, gynæcological, obstetric, as well as ear, nose, throat and eye cases. In addition to his purely medical work he is medical officer of health for the district, and here he has three sanitary districts at Bo, Blama, and Kennema. At Bo he has two sanitary gangs, one for the town and one for the European reservation. He has to deal with all sanitary affairs, and be ready to tackle any outbreak of infectious disease. Meteorological observations are taken at Bo daily by the dispenser, but the medical officer is responsible for their correctness.

The medical officer is the medico-legal expert of the district, and is called upon to make post-mortem examinations or superintend exhumations, as well as to give evidence in the District Commissioner's Court and Circuit Court.

Scientific.—The average medical officer is not a trained laboratory worker, but there are opportunities of doing minor research works such as collecting the different mosquitoes and biting flies in the district, examining children for the local splenic index, examining children for ankylostome and other helminth ova. During this time (in my spare time) I have been doing helminthic investigations, and also collecting figures for a paper on fertility and infantile mortality rates.

Lastly, he has a good deal of clerical work to do, official correspondence, monthly, quarterly, and yearly returns. At present at Bo there are fourteen monthly returns to be made. I am told that in the army there is an excessive amount of office work. I do not know, but I think the medical department out here is a good second.

The day's work begins in the dispensary at 8.30 or 9 a.m. The old ulcer cases come earlier and are all dressed by now. One sees first of all the Government officials from the various departments; at this station there are the railway, public works, roads department, and Bo school (a Government School for the sons and nominees of chiefs). At Kennema there are also prisoners, court messengers, and headquarters administrative staff. After this one deals with the general populace—the proportion of Creoles attending is very high. The rest of the morning is taken up with clerical work and sanitary inspection with the inspector. In the afternoons operations can be done, if any, or microscopical work and any urgent case that may be brought in. Also the claims of private patients can be considered.

Recreation.

Recreation.—"All work and no play makes Jack a dull boy." Tennis—there are two courts at Bo and one at Blama and Kennema. There is a golf course at Bo, and at Bo school occasional games of cricket and football with the schoolboys are to be had. There is little shooting—bush-fowl, guinea-fowl, and pigeons round about Bo. The bush is too thick for other shooting. There are good roads, as already mentioned, for walking and cycling.

Types of Cases Treated.

During the period under review 2,067 new cases attended at the dispensary and I had 200 private patients. Though this is the most populous district there are only eighty to the square mile, the average for the whole Colony and Protectorate being about sixty to the square mile; not by any means a dense population.

The commonest are ulcers, constipation, dyspepsia, minor injuries and coughs and bronchitis, and rheumatic affections.

Ulcers of all kinds are met, and, in children, the tropical ulcer with its rapid extension and sloughing is very common. Any little cut or abrasion if neglected soon becomes one of these foul ulcers. Even at the Bo school, where the boys have daily access to the medical officer and dispensary and live under much better hygienic conditions, these ulcers occur.

Venereal diseases—primary syphilis and recent gonorrhœa cases do not present themselves in large numbers. One sees relatively much more of advanced tertiary syphilis and stricture cases with perineal

abscesses and fistula of old-standing gonorrhœa. The gonorrhœal stricture cases are seen very late and often have several strictures. The tertiary syphilitics respond very well to novarsenobillon, stabilarsan, bismuth salts sufarsenol, all of which I have tried here by intramuscular or intravenous routes.

Phthisis is not common, but only a virulent type is met with and a fatal result soon follows. No typhoid cases occurred.

The idea that primitive races have perfect teeth and have no need for dentists, in this part of the world at any rate, is quite erroneous. Dental caries, especially of the molars—the sixth year molar being the first to go—and pyorrhœa is frequent among both the Mendis and Creoles. The commonest minor operation done is the extraction of teeth.

Only a few of the diseases described in standard works on tropical diseases are fortunately met with here. As far as I know plague, cholera, kala-azar, pellagra, sprue, guinea worm, trypanosomiasis, relapsing fever, dengue have not been described. Bilharzia and ankylostome infections (*Necator americanus*, 98 per cent.) are present, but do not seem to cause symptoms as in other parts of the tropics. Yellow fever has occurred but is rare. Leprosy, too, is not common and the people do not seem to have any particular dread of it and allow lepers to move about freely. Amboeic dysentery occurs, but not to a large extent, considering that the land near or on the banks of the streams is the common latrine ground of the Mendis. The commonest tropical diseases, next to the tropical ulcers mentioned above, are malarial (subtertian or æstive-autumnal) with its sequelæ. Benign tertian and quartan malarias are rare. A large part of the infantile mortality may be due to cerebral malaria. Blackwater fever has occurred at Bo but not during this period. Trachoma is rare.

Of the infectious diseases most commonly met with out here, small-pox and chicken-pox, there have been no cases. Two mumps and one case of measles were seen.

Yaws is rare in the primary stage, and the secondary manifestations are so like those of syphilis that in the absence of the Wassermann test it is hard to differentiate them, especially as both are cured by the 606 group.

Filarial embryos are common in the blood, but the clinical manifestations are proportionately few. Elephantiasis scroti is the commonest, with one or two cases of elephantiasis of the legs.

To show what class of surgical work one has to deal with out here, the following operations, except those for cataract, were done under chloroform:—

For Elephantiasis scroti	1
Radical cure of hydrocele	2
Senile cataract	3
Aspirating liver abscess	3
Incision of large mammary abscesses, buboes, &c.	6
Removal of keloids	3
Incision of eyeball	1
Circumcision	4
Suturing large wounds	2
Obstetric complication for incomplete abortion	1
Emptying uterus sapræmia	1
Internal version for transverse presentation	1

Eye cases are not as common out here as in India, the ones that come up for treatment are mostly cases of simple conjunctivitis, and cases of old extensive scarring of the cornea for which nothing can be done. Trachoma is very rare, none seen here in this period and only a few cases of senile cataract.

The European population is small and can therefore be considered in detail. The average is 38, distributed as follows: Bo 15, Gerihun 1, Blama 11, Baoma 1, Kennema 1, Hangha 1, and Boajibu 5. European ladies resided at: Bo 1, Kennema 1, Blama 2, and Boajibu 1.

No European died but 4 were invalided: 1 for phthisis, 1 for wound on the leg, 1 for liver abscess and 1 for toxæmia of unknown origin. Europeans treated: women 1 (malaria), men 9, in addition to those invalided, bronchitis 1, malaria 3, sprained ankle 1, local boils 1, bronchitis 1, nasal catarrh 1, dyspepsia 1.

Private Practice.

The amount of private practice depends more than anything on the medical officer's attitude towards the Natives and Creoles. The sympathetic medical officer gets all that is going, and the man whose general attitude the people do not like gets little or none. Two hundred cases may be taken as on the large side for eight months. The relative proportions of the different elements of the population met with in private are quite different to those met in the dispensary. In private the bulk of patients are better-class Creoles and Syrians. The following is an analysis of the different nationalities:—

Creoles	93
Syrians	57
Natives, including chiefs	42
Europeans	8

Two-thirds of the Creole cases are females, and the great bulk of the private work is of gynæcological and obstetric nature. Nearly every type of disease of women is met with: dysmenorrhœa, amenorrhœa, menorrhagia, pseudocyesis, normal and abnormal delivery, eclampsia fever abortion, prolapse and retroversion filbroids, ovaritis and ovarian tumours, chronic erosion of the cervix. Among the aboriginal tribes very few of these cases are seen as the women will not tell a man about such symptoms, or allow a man to make the necessary pelvic examinations.

Of the general cases treated in private, malarial type of fevers are commonest, next comes tertiary syphilis, than cases of dyspepsia. Gonorrhœa, a few cases. The proportion of eye cases is greater than at the dispensary, and includes the cataract cases mentioned in the operation list. Rarer cases are heart cases, amœbic dysentery, liver abscess, hemiplegia, hydrocele and elephantiasis scroti, and bronchial affections.

In the above account I have not been able to give any thrilling accounts of exceptional cases to be treated, but as the benefits of medical science become more and more widely known and more equipment is obtained, more and better work will be done. The foregoing particular account of eight months' work at Bo is typical of any similar period at any other district in this Colony and Protectorate, and, with the changing of a few names and figures, is a fair index of work in the other West African Colonies.

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NOMENCLATURE IN MEDICAL ZOOLOGY.

THE present state of confusion that exists in the nomenclature of the animal parasites of man is most distressing to the medical man, and any steps which will result in a greater uniformity are highly to be commended. In consulting a series of text-books it is quite frequent to find oneself at sea, owing to the diversity of names to be applied to any one organism, and it is next to impossible to expect the busy practitioner to carry in his mind a long list of synonyms. Possibly the greatest trouble in this respect is found in the names of the pathogenic and non-pathogenic human protozoa, and, as an example of the extreme confusion which exists, the pathogenic amœba of the human intestine and the commensal, which so closely resembles it, may be cited. To the systematist it is no doubt a matter of some importance to decide whether these amœbæ should be given the generic name *Entamœba*, *Endamœba* or *Poneramœba*, and whether it is correct to apply the specific name *coli* to the commensal or to the tissue parasite. But to the medical man, on the other hand, who has his interest centred on diagnosing the presence of the pathogenic form in the fæces of his patients, it is confusion worse confounded to find in his works of reference different names for the same organism.

It is not for a moment suggested that there should be any gross departure from the established rules of zoological nomenclature; the point at issue is that in the past there has been disagreement under these rules even among those who make a study of the systematic position of the various organisms, and there does not seem to be any prospect of this diversity of opinion being settled in the near future. Now, since these controversies chiefly rage round questions of historical import rather than on matters of present-day research, and since the utmost the authorities can do is to produce a series of "opinions," which as often as not clash one with the other, some other means, either of a temporary or permanent nature, will have to be adopted to straighten out the mazes of the literature and so lighten the already all too heavy burden of the student of medicine.

The same muddle exists in practically every branch of medicine which deals with parasitic organisms of man, be they animal or vegetable. A good example of this is the spirochætes. What does it matter whether the spirochæte of syphilis be called a *Spironema*, a *Treponema* or a *Spirochæta* so long as the patient has adequate treatment?

The human whip worm is variously referred to as *Trichuris trichiura* and *Trichocephalus dispar*.

To suggest any means of rendering order out of the present chaotic condition of affairs is extremely difficult, and a matter to be approached with the greatest delicacy. It seems feasible, however, that the Zoological Congress might arrive at some solution of the problem by agreeing on the names to be applied to organisms whose morphological characters and life cycle are now more or less established, but about whose names, owing to diversity of opinion in the past, there is now some doubt. Next it might be suggested that, so far as the medical side is concerned, one name might be adopted for any given organism for a stated period, and if further research—by which is meant true investigation into the character of the parasites and not merely an expression of opinion on the findings of some worker, say of the last century—should show that any alteration in the adopted name was necessary or advisable, such alteration would only take place after due con-

sideration and at the expiration of the stated period.

While there is no doubt that the systematists are the worst offenders in this changing about of names, vacillating from one to another without practical reason, attention must be drawn to the frequent "rediscovery" of organisms already known and described as a fertile means of increasing the crop of synonyms. Such rediscoveries are certainly from the present viewpoint of less importance than the *obiter dicta* of the systematists, since the bulk of opinion usually causes their stultification in a comparatively short time; but, nevertheless, as no textbook would be complete without their mention, they do add to the continually growing synonymic list.

On this matter of nomenclature there seems to be no question of what the opinion of the medical profession really is; unfortunately, it is notoriously difficult to raise enthusiasm to a pitch sufficient to ensure the necessary change.

J. G. T. and A. R.

Annotations.

Injuries and Diseases in Australia attributable to Animals (except Insects) (J. Burton Cleland, *Medical Journal of Australia*, October 4, 1924).—The first injuries mentioned in this paper are those from aboriginals, which are often very serious and end fatally. Camels have been known to inflict fatal injuries, also the flying fox. Rats, of course, are numerous and are well known as the reservoir of the plague bacillus and the transmitter of the organism of rat-bite fever. Injuries are also recorded of wombats, crow-shrikes, butcher birds and cassowaries, and a case is described of a "severe lacerated wound of the leg, caused by the bite of a shark." The numb-fish is known for the electric shocks it conveys to man, and there are several fish known to convey injuries by their spines. The consumption of the toad-fish has caused death in many instances. Among other injuries described are those from scorpions, ticks and spiders.

Tetanus Cured by Large Doses of Serum (Trabaud and Baur, *Bull. Soc. Med. des Hop. de Paris*, October 16, 1924).—Two cases are reported. The first, a girl, 6½ years, admitted into hospital complaining of stiffness of the jaw of five days' duration. There was nothing in the mouth to account for the trismus, but for the last three days there had been general tetanus. The pulse varied from 120 to 130 and the temperature was 100° F. The cause of the tetanus was a small wound in the sole of the foot, due to treading on a nail about ten days previously. In the first three days 430 c.c. of antitetanic serum were given; some chloral was also given at night. The patient quickly recovered, suffering no inconvenience from the serotherapy beyond slight erythema and enlargement of the glands. The second case was a woman who had fractured her astragalus; a fragment projected through the skin. The fragment was removed, and 10 c.c. of antitetanic serum given, the wound dressed and put in plaster, 30 c.c. of antigangrene serum was then given. Temperature 105° F. Pulse 98 to 110. Sloughing of the skin occurred six days later, and 50 c.c. of antigangrene serum was administered. After a few days a localized tetanus set in and doses of 100 c.c. of antitetanic serum were given daily, which was later followed by doses of 50 to 20 c.c., 740 c.c. being given in all the course of the disease. The patient eventually recovered.

The Effect of Alcohol and Nicotine on Salvarsan Treatment (Hubner, *Dermat. Woch.*, October 22, 1924).—The number of cases within recent years which have been refractory to salvarsan are not few. Silberstein's experience at the Konigsberg University Skin Clinic is particularly interesting. During 1911 to 1916, the Wassermann reaction became negative in 100 per cent. of the cases treated, and remained positive in 23 per cent. during the years 1921 and 1922. At Elberfeld the author has had similar experience, 1919 to the middle of 1922, but since that date the results have been decidedly better. The improvement may have been due to the use of silver-salvarsan, but is chiefly attributed to a restricted consumption of alcohol and nicotine. The author maintains that alcohol and nicotine paralyse the natural defence of the body, without which salvarsan cannot produce its effects. His conviction is based on the much better results obtained in patients in the prison at Elberfeld, among whom the action of alcohol and nicotine could be eliminated both before and during treatment. At the end of the course of treatment only nine out of 100 patients still gave a positive Wassermann reaction.

On the Dissolution of the Precipitates produced in the Leutic Precipitation Test by the Fresh Serum (Kiyowo Taoka, *Kitasato Arch. Experimental Medicine*, vol. vi, No. 1, August, 1923).—By allowing carbonic acid gas to pass through the fresh serum or by adding some N/400 acid into the serum, the capacity of the fresh serum to dissolve the leutic flakes disappears although no changes are met with in the complimental activity. Both the leutic flakes treated with acid and the flakes not complement-fixed are dissolved by the fresh serum. By heating the serum the pH is lowered to 7·0, when the capacity of the serum to dissolve the leutic flakes is lost. The dissolution of the leutic flakes by the fresh serum is due to the alkalinity and is quite independent of its complemental activity.

The Role of Monilia Psilosis (Ashfordi) in Experimental Sprue (L. Weld Smith, *Journal of the American Medical Association*, November 15, 1924).—Experiments support Ashford's theory of the specific etiology of sprue as due to *Monilia psilosis* by the production in guinea-pigs of a chronic moniliasis with gastro-intestinal lesions roughly comparable to those found in man. The development of the lesions, however,

was rarely noted except in animals fed on a diet partially deficient in vitamins, especially the anti-scorbitic vitamins. This favours the view that a deficient diet, or diminished resistance such as is common following long residence in the tropics associated frequently with gastro-intestinal infections such as amœbic dysentery, are contributory factors in its production. Mycologic studies on twenty-one strains of monilia obtained from Manila and from cases in Boston invalided home are in accord with the tentative classification into three subtypes—A, B and C—as suggested by Boyd and Hannibal.

The Production of Immunity Against Plague by Vaccine. III. Immunization by Oral Administration of Plague Vaccine With and Without Bile (J. Morrison, B. P. B. Naidu and C. R. Avari, *Indian Journal of Medical Research*, October, 1924).—Rats which are very satisfactory for estimating the prophylactic value of plague vaccines, when administered by the subcutaneous route, are not suitable animals for the oral administration of bile and vaccine. They have not been induced to eat baits prepared with bile and when bile is administered by a catheter they appearently die readily of œdema of the glottis. Guinea-pigs can be fed with bile by a catheter. The treated guinea-pigs receiving doses similar to those given by M. Leger and A. Baury afford no evidence that any immunity is conferred by the oral administration of bile and the plague prophylactic or by the oral administration of the plague prophylactic alone.

The Production of Immunity Against Plague by Vaccine. I. Haffkine's Plague Prophylactic. (J. Morrison, B. P. B. Naidu and C. R. Avari, *Indian Journal of Medical Research*, October, 1924).—Rats imported from Madras for these experiments showed mortality of 9·2 per cent. within six days of their arrival. When infected with 0·003 mgm. of spleen of a plague infected rat, these rats showed a mortality of 95·3 per cent. within ten days of infection. Nutrient broth from which Haffkine's prophylactic is made is not toxic to rats and it has no immunizing value. The whole prophylactic given in a dose of 0·5 c.c., killed 35 per cent. of rats from toxæmia and produced an immunity which reduced the mortality among infected rats from 95·3 per cent. to 55·6 per cent. The sediment in the dose employed showed neither toxic nor immunizing properties. The supernatant fluid caused a mortality of 19·8 per cent. from toxæmia and produced an immunity which reduced the mortality to 53·11 per cent.

The Production of Immunity Against Plague by Vaccine. II. Agar Cultures (J. Morison, B. P. B. Naidu and C. R. Avari, *Indian Journal of Medical Research*, Oct., 1924).—When compared with 0·5 c.c. of Haffkine's prophylactic, agar cultures treated with formalin and acetone are not toxic and show no evidence of immunizing power, even in doses of 12·5 mgm. Agar cultures treated with chloroform vapour and 1 per cent. carbolic acid show no immunizing power until the weight of the dried vaccine exceeds 13·6 mgm. Agar cultures treated with 1 per cent. carbolic acid possess immunizing properties when used in a dose of 8 mgm. When heated at 60° C. for fifteen minutes and then carbolized to contain 0·5 per cent. carbolic acid possess immunizing value with doses of 4 mgm. and upwards. Only with heated vaccine does the toxicity regularly increase with the dose.

The Nature and Pharmacological Action of Cholera Toxin (H. W. Acton and R. N. Chopra, *Indian Journal of Medical Research*, October, 1924).—The cholera vibrio, as is well known, can liquefy gelatine, and reduce the amino-acid tryptophane to indol: the authors show that it can also decarboxylate amino-acids into poisonous bases. The protein bases found in a ten days' cholera broth culture consist of two main fractions, volatile and non-volatile bases. The volatile bases are almost devoid of pharmacological activity on the tissues tested, but they cause a tonic contraction of the rabbit's intestine. The non-volatile bases contain the poisonous toxins, which depress blood-pressure, &c. These poisonous bodies are found in the arginine fraction of the non-volatile amino-acids so that they only form a small proportion of the non-volatile bases. The main action of these toxic bases are: (1) A fall of blood-pressure due to vasodilation of the vessels supplying the small intestines, combined with an increased permeability of the vessel endothelium; (2) direct action on the secreting tubules of the kidney which are further hampered with the occurrence of an intertubular œdema as soon as the blood-pressure rises to normal. (3) An oxytocic action on the pregnant uterus, causing miscarriages. The optimum conditions for the production of these bases are the necessary amino-acids, pH on the alkaline side, and a liberal supply of oxygen.

Contribution to the Biological Study on the Hæmolytic Streptococci (Koji Ando, *Kitasato Arch. Experimental Medicine*, vol. vi, No. 1, August, 1923).—Hæmolytic streptococci isolated from diseased sites, as a rule, have a certain hæmolytic zone. Among the hæmolytic streptococci isolated from normal mucous membrane there are some which show the same hæmolytic zones as those isolated from diseased sites, while others have different zones. Therefore, those hæmolytic streptococci which show a certain definite hæmolytic zone without regard to the sources, isolated from either normal mucous membrane or diseased sites, are classified as typical β type, and all others which are not included in the typical β type are classified as atypical β type. About half of hæmolytic streptococci found normally on healthy mucous membrane is atypical β type. The atypical β type may be divided into five types by the characteristics on blood agar plates. While the typical β type has marked pathogenicity, the atypical β type has very little. This was proved by the virulency and hæmolysin producing function in bouillon not containing serum.

The Relation of Silver Arsphenamin to the Involuntary Nervous System and to the So-called Nitritoid Crisis (I. Rosen, E. Friedrich Müller and C. N. Myers, *Archives of Dermatology and Syphilology*, vol. x, No. 5, November, 1924).—In these observations it is shown that every intravenous injection of arsphenamin is followed by a slight decrease of leukocytes in the peripheric vessels of the entire body, indicating a reaction of the involuntary nervous system. This decrease is marked in patients who develop manifestations of the so-called nitritoid crisis. Intravenous injections of silver arsphenamin are generally unaccompanied by any change in the leukocytes, thus indicating that there is no reaction or disturbance of the involuntary nervous system and the vascular system of the body. The only exceptions to this rule are found in a few persons, namely, the same who develop symptoms of the so-called nitritoid crisis after injections of arsphenamin. This is further proof that the rare reaction after silver arsphenamin is caused by a previous disturbance of the involuntary nervous system and is not occasioned by the drug itself.

Hepatosis (or Tropical Abscess of Liver) : An Examination into the Diagnosis and Treatment of this Disease in India, with Special Reference to the Use of Emetine (R. S. Townsend, *Journal of Royal Army Medical Corps*, December, 1924).—During the past fifteen years the author has carried out many investigations on this subject and has seen numerous patients suffering from the disease. The summary of his paper may be given: "I know that it may be said that there are few new statements and facts in this thesis. I may, however, claim that a review of the literature, before and after the introduction of emetine, and one's own experience show that liver abscess must now be looked at from a new perspective. The diagnosis has become even more difficult, and the typical cases are not so common. I will sum up my findings as follows:—

The disease is irregularly distributed in the Tropics. It has definite relation to amœbic dysentery, and is definitely caused by *Entamœba histolytica* in the liver substance. Whilst the treatment by emetine has reduced the incidence and mortality tenfold, it has still a high mortality rate. In India it is much more common in men than in women. Whilst alcohol is a most important factor, debility and congestion of the liver are also predisposing causes. Distribution is most irregular in India, and it may occur at any season. That, as a result, the chances of missing cases are very greatly increased. Unlike before the days of emetine, it is now rare to find abscesses and acute dysentery at the same time. They are generally sequelæ of dysentery. There is no royal road to diagnosis. The train of symptoms is various, and little aid is obtained from X-rays and chemical tests. A history of dysentery, a muddy complexion, a remittent septic temperature, a tender liver, drenching perspiration, a relative anæmia and leucocytosis are sure signs of liver abscess. Shoulder pain is not so sure a sign as text-books suggest. When a liver abscess is diagnosed, operative procedure must be continued until it has been evacuated. If emetine does not clear up the hepatitis, it should be treated by surgical means at a very early date. The causes of failure in order of rarity are: (1) Non-diagnosis, especially of abscess of left lobe. (2) Incomplete evacuation. (3) Secondary infection, by evacuation into the chest or abdominal cavity.

Final Report on the Use of Urea Stibamine in Kala-azar (H. E. Shortt and Ram Taran Sen, *Indian Journal of Medical Research*, October, 1924).—A series of cases of kala-azar have been treated, further to those reported in 1923, which show that the value of urea stibamine has been established as the most efficient drug at present in use for the treatment of Indian kala-azar. This conclusion is based not only on the cases published, but in addition on experience gained in many other cases, both Indian and European, which have passed through the hands of the authors, or which have been treated with urea stibamine under their direction, a number totalling nearly 100 cases.

Attempts to transmit Rheumatic Fever to Rabbits and Guinea Pigs (C. P. Miller, *Journal of Experimental Medicine*, October 1, 1924).—In a series of attempts to transmit a virus from patients in the acute stages of rheumatic fever, twenty-seven rabbits and fourteen guinea-pigs were inoculated with one of the following materials: whole blood, serum, joint fluid, pleural fluid, throat washings, suspensions of tonsil tissue. Subsequent transfer inoculations from animal to animal brought the total number of animals employed in the experiments to sixty-seven rabbits and forty guinea-pigs. Only two animals developed an acute non-bacterial arthritis. No other evidence of successful transmission of the disease was obtained. In about one-half of the rabbits and two-thirds of the guinea-pigs myocardial lesions were encountered which consisted of interstital accumulations of lymphocytes and endothelial cells. Similar lesions were found in control animals.

Amœbic Liver Abscess with a Report of Two Cases occurring in Connecticut (M. Lear and E. S. Merrill, *Ann. Surgery*, May, 1924).—Two cases of amœbic abscess of the liver are described, and an account of a small local outbreak of amœbic dysentery in Connecticut is given. The first case occurred in a male and the second in a female. X-ray examination showed elevation and fixation of the right dome of the diaphragm and enlargement of the liver. In both cases a definite solitary abscess was found; open operation by the subcostal route was performed. In the authors' opinion treatment by aspiration and systematic emetine medication gives better results than open incision and drainage, in which failure may result from secondary pyogenic infection. There was no evidence of recurrence in either case.

Current Literature.

BULLETIN DE LA SOCIETE DE PATHOLOGIE EXOTIQUE. December 10, 1924.

On Human Intestinal Spirochætes in Portuguese India (F. de Mello and B. P. Mesquita).—Examination of a number of individuals, without the least sign of intestinal trouble, either at the time of examination or during the previous six months, showed the presence of *Spirochæta eurygyrata*, often in abundance, so that it is difficult to attribute any pathogenic rôle to this parasite. The presence of this spirochæte in patients suffering from intestinal trouble varied from 0 to 50. The spirochætes of the alveolar arch *S. buccalis* are found in the human intestine, where they retain the same characters as in their usual site.

Experiments on the Treatment of Human Spirochætosis due to S. eurygyrata, by Modern Spirillicides (F. de Mello and B. P. Mesquita).—Neosalvarsan in intravenous injections of 0·3 to 1·7 grm. has no action on *S. eurygyrata*. Results were also negative with the use of the bismuths, Muthanol, Neotrepol and Trepol, the first in doses of 10 c.c., the other two of 6 c.c., given in intramuscular injections of 2 c.c. every other day. Dermatol, given *per os*, 1·5 grm. per day for six days, had no effect on *S. eurygyrata*. Stovarsol tablets administered *per os*, three tablets per day for six consecutive days, has a remarkable action on *S. eurygyrata* and is considered the best medicament for spirochætosis.

Anatomic Considerations on the Structure of the Paranasal Tumours of Goundou (Botreau-Roussel and L. Cornil).—Contrary to the affirmation of a certain number of authors, paranasal formations of goundou are not tumours in the anatomopathological sense of the word, but are osteogenic inflammatory hyperplasias, as previously shown by Durante. These hyperostoses present general characters, trabecular and medullary modifications, comparable to those of syphilitic osteitis. The histological characters of the lesions prove goundou to be of frambœsial origin.

Trachoma at Tangiers (P. Remlinger and L. Bernard).—Trachoma does not exist at Tangiers, either in endemic or epidemic form. The cases found are imported. The disease is rarer at Tangiers than in equally important towns of Algeria and Tunis, and other ports of the Mediterranean. It is more commonly seen in adults than in children. It is only slightly contagious, and does not constitute a danger for the town itself or for the countries with which it trades. Under present conditions, simple measures of surveillance are necessary rather than an aggressive prophylaxis.

On the Parasitology of Arequipa (Peru) and the Neighbouring Places (E. Escomel). This paper gives the results of the author's fifteen years' investigation. Arequipa is one of the healthiest towns of South America, and the least rich in parasites pathogenic for man and animals. The maladies met with are generally of foreign origin.

On the Abusive Use of Quinine in the Treatment of Pyrexia (H. Lhuerre).—The author points out the too common mistake of giving large doses of quinine in cases of pyrexia and malaria, which often cause serious trouble. The condition of the patient should first be taken into consideration, also the pathological differences of each patient; and the words of Pasteur on his death-bed, relating to this subject, should be borne in mind, " Ce n'est pas le microbe, c'est le malade qui fait la maladie." Three instances are given where the prolonged illness of the patient was due to too large doses of quinine.

Note in the Intestinal Affections in the French Sudan (Cercle de Mopti) (R. Lefevre).—Intestinal diseases, contrary to general belief, are very widely spread in the Sudan; dysentery, especially is frequently found in the Valley of the Nile and the region of Mopti. In the white race fifteen cases have been observed in one year; all of amœbic type. This is accounted for by the consumption of raw vegetables and polluted water from the Nile. In the examination of 127 stools, *Entamœba dysenteriæ* was found sixty-nine times, *Lamblia intestinalis* once, *Schistosoma hæmatobium* once, *Ankylostoma duodenalis* once and *Balantidium coli* once. The sixty-nine cases of amæbiasis do not signify the number affected, as the natives only come for consultation when in the acute stage of the disease.

Characters of Spirochæta bronchialis Castellani (Froilano de Mello).—This paper is based on a study of the spirochætes of six cases of broncho-spirochætosis observed in Nova Goa. Broncho-spirochætosis is generally discovered by chance in the laboratory, sputums being nearly always sent for the discovery of the Koch bacillus or other agents. The spirochætes have been studied on fresh sputum and are described in detail. These studies show that *S. bronchialis* is a separate species, distinct from the spirochætes of the alveolo-dental arch.

Concerning the Efficacy of Preventive Quinine in the Prophylaxis of Malaria (J. Legendre).—Quinine as a preventive of malaria has been used for over fifty years, since the discovery by Maillot of the specific rôle of quinine in the treatment of the disease. Preventive quinine at one time rarely exceeded doses of 0·25 gr., but nowadays as much as 0·40 and 0·50 gr. per dose is taken. The author is convinced that quinine as a preventive of malaria is not efficacious, and that given in large doses may often do more harm than good.

Intestinal Coccidiosis of Vipera berus due to Cyclospora babauli nov. sp. (Mme. Phisalix).—Three vipers, *Vipera berus* Lin., captured in the province of the Yonne, were found to harbour numerous coccidia in the intestine, showing the two forms of multiplication which are described in this paper. The coccidia of *Vipera berus* is very similar to the one found in *Vipera aspic* and named *Cyclospora viperæ*. In this case the coccidia is named *C. babauli*, after M. Guy Babault, who captured the vipers.

Original Communications.

THREE CASES OF CASTELLANI'S ENDEMIC FUNICULITIS IN KENYA COLONY.

By N. P. Jewell, F.R.C.S I., M.D.
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Endemic funiculitis was first described as a separate disease by Castellani in Ceylon some years ago. According to him the condition was known, though very imperfectly, to the local practitioners for many years, and considered to be of venereal origin or of malarial origin. Cases have been recently recorded from Southern India and Egypt. So far as I know, the present three cases are the first to be recorded from Eastern Africa. I am of opinion that this disease is endemic to this part of Africa.

That the disease is one *sui generis* there can be no doubt in the mind of anyone operating on one of these suppurative cases. The appearance of the spermatic cord is quite characteristic, and, on cutting into it, the pus wells out of the veins in a way that, once seen, is never forgotten.

The ætiology of the disease is, at present, uncertain, but in one of my cases (the Mombasa one) I found the diplo-streptococcus mentioned by Castellani. In none of my cases was bilharzia known to exist, nor was there any sign of micro-filaria. It would seem from the sudden acute severity of the disease, that a streptococcal origin was most likely, but I am informed by Dr. Nair, of Mombasa, that he had a case corresponding to the description of endemic funiculitis in which he was able to obtain micro-filaria in the blood, and he further stated that he had seen several similar cases, but had been unable to obtain filaria in the blood, although he regarded the cases as filariasis. These cases must have been of the mild variety mentioned by Castellani, as none of them were treated surgically and all recovered under medical treatment.

It would seem that there are two definite varieties of the disease. *One*, a mild type in which the causative organism is the micro-filaria and which is capable of cure without surgical aid. *Two*, a severe type, with septicæmia and destruction of the cord, the cause of which appears to be a diplo-streptococcus. It may be that these two types represent two separate diseases, i.e., the mild type being a manifestation of filariasis, and the severe form of endemic funiculitis proper.

It will be seen that the three cases recorded fall at once into two groups, one, the Kisumu case—mild in comparison to the other two, treated medically and going on to recovery without suppuration. This was probably a filariasis case. The other two are of the severe type, probably both diplo-streptococcal, both suppurative and requiring immediate operation.

As regards the diagnosis in the severe form, the condition is not at all unlike a strangulated inguinal hernia—the sudden onset, with tense swelling in groin coming on quickly, with no impulse on coughing, and marked shock, and, as in one of my cases, a history of inguinal hernia on that side, suggest strongly the latter condition, more especially as the history to be obtained from natives is generally very unreliable.

Case 1.—*At Kisumu, in* 1918.—My own personal boy, a Kikuyu native, aged about thirty years, was suddenly taken ill with rigor, vomiting and great pain along the right spermatic cord. The cord rapidly enlarged to about one inch in diameter and the temperature rose to 103° F., the pulse was fast and of low tension.

There was a history of gonorrhœa several years ago, but no recent history of infection. There was no history of injury, and no signs of filariasis.

I was puzzled by the case and could not classify it at all. On looking up a text-book on tropical medicine I found a reference to endemic funiculitis, and, on comparing the description with the case in point, I was satisfied that I was dealing with a case of that disease.

I treated this case with boracic foments two-hourly and, later on, local applications of iodine. Internally, urotropine and acid. sol phosp. gr. 10 of each, four times daily, and saline purges each morning. The condition gradually subsided in about ten days and left no after-effects.

Case 2.—*At Kismayu in* 1922.—The patient was an elderly man, who was under treatment in hospital by Dr. Davison for ankylostomiasis and was very debilitated. He had suddenly developed a swelling, either the previous night or the early morning, over the left inguinal canal and into the scrotum. The swelling was tense and very painful, with no impulse on coughing. The overlying skin was normal. The temperature was normal, but the pulse was fast and thready. There was a history of inguinal hernia on that side. I made the provisional diagnosis of strangulated hernia and suggested immediate operation, which was agreed to. On making the usual incision over the inguinal canal, pus came into the wound on division of the subcutaneous tissue. Mixed with the pus was material that looked like, and smelt like, semen. On gently feeling in the wound I found the cord greatly enlarged and gangrenous, and the examining finger passed readily through the disintegrated tissue down to and into the epididymis and testis. The wound was enlarged and freely opened up and the dead tissue gently cleared away and free drainage established, but the patient died the same day.

Case 3.—*At Mombasa*, 1923.—This case was seen in consultation with Dr. Massey at the Native Civil Hospital. The patient was a young man of thirty years, with a swelling from the testis into the inguinal canal. His temperature was 100° F., the skin over the swelling was freely movable, the testis was at the bottom of the swelling and was normal, there was a little fluid in the tunica vaginalis, his bowels had worked the previous day. We could not obtain any history of hernia.

History.—The history obtained from the boy was as follows: Three or four days before coming

in he had had a sudden attack of fever and vomiting, there was pain and swelling along the spermatic cord on the left side. The pain was very severe. There was no history of venereal disease, but he suffered from constipation, although, as already noted, the bowels had worked the previous day. The swelling was tense and dull on percussion. The condition resembled a strangulated omental hernia into a patent vaginal process. As we were not certain of the diagnosis and there was a possibility of the condition being a strangulated hernia, it was considered wise to operate at once, and this was done. On cutting through the skin and subcutaneous tissue, one came at once on the greatly inflamed spermatic cord, which was about one and a half inches in diameter. An opening was made into the cord from the inguinal ring to the epididymis, and about one inch deep. On cutting into the cord pus welled out from the cut veins and connective tissue. The whole wound was cleaned out with dioxide and left open. A boric fomentation was used as dressing, and this dressing was repeated two hourly during the next few days, at each dressing the wound was irrigated with dioxide. Recovery was uneventful.

LITERATURE.

CASTELLANI and CHALMERS. "Manual of Tropical Medicine," 3rd Edition, p. 1939.

LIGHTNING STROKE AND ELECTRIC STORMS IN THE TROPICS.

By H. A. SPENCER, M.R.C.S., L.R.C.P.Lond.

DURING a long residence in the Transvaal, South Africa, with its continental climate some hundreds of miles from the seaboard, it has been my experience to witness, and far too often to be involved in, the often terrific displays of electric storm which occur every summer with unfailing regularity. The man whose duties constantly take him far away over the bare veld at this time of the year, where there are few trees to act as possible lightning conductors, himself runs great risk of acting in this manner during storms which come up so quickly, appearing in a previously cloudless sky with scant warning, as he travels about, for he cannot avoid exposure to their fury. It is just this risk which is apt to make him ponder, as he travels, upon the source, vagaries and general conduct of atmospheric electricity, to turn over in his mind the possible means of avoiding being struck and the various methods of resuscitating those who have been so unfortunate.

ATMOSPHERIC ELECTRICITY

is, as we all know, resident in the upper altitudes of the atmosphere even in the clearest and brightest of skies; when humidity is driven higher and higher by the up-rushing heat from the baked earth, and reaches the heights of condensing cold it becomes visible cloud, which, driven still higher, becomes electrified. Now the condensing action of electricity upon water vapour is well illustrated by approaching an electric current to a playing fountain of water, issuing so finely divided that it can only be seen but falls noiselessly into the basin like soft rain falling without splash; each time the current is approached, however, the spray is at once seen to become denser, more coarse, and falls into the basin with a loud splash, whilst each time it is removed the spray returns to its vaporous form. What happens is that the molecules of water when they collide in the air rebound from each other, but in the presence of electricity they at once coalesce whenever they touch, forming larger and larger drops, which are of course far heavier than mist. In this manner the electrified cloud in the upper atmosphere becomes heavier and heavier and rapidly falls to earth with its contained electricity. I think this electrical action upon water vapour fully explains the sudden appearance of these electric storms in the heat of summer; at one moment the atmosphere with its invisible water vapour is clear and bright, at the next, almost, a lowering cloud is seen rapidly descending earthwards filled with potential "lightning."

Applying what happens to one cloud to enormous quantities of water vapour over a particularly hot spot of the ground, it is easy to see what further happens: that clouds, above others, becoming overcharged are constantly forced to off-load into contiguous clouds within their reach, this going on from above keeping up the supply of lightning from the higher altitudes to earth. An overcharged and very heavy cloud which has dropped away from contact above is a source of terrible danger to life and property under certain conditions, when it discharges its whole content of electricity at one contact with enormous force in one impulsive rush! Terrible injuries are then produced upon men and animals; lightning conductors are practically useless against it!

CONDUCTION OF LIGHTNING BY OBJECTS AND HUMAN BEINGS.

Falling rain is the commonest conductor of the lightning from cloud to earth, and the most anxious time on the veld is that preceding the fall of rain, when heavy thunder-clouds are lowering and lowering overhead and a flash may come at any moment; for the lower surface of the cloud is surcharged with positive electricity, as it passes over the earth's surface, held there by the attraction of the negative electricity following beneath it on the ground, flowing across the veld, up hill and down dale, up trees it meets in its path or any object travelling along—ever trying to rise high enough to make connection with that ever-falling-lower above, and to thus complete the circuit. Whenever the jump becomes short enough between the two for this to occur, the cloud sparks to the earth—a flash of lightning falls—and whatever assists the contact of the electricity above with that below will receive the full force of the discharge and conduct it to earth. Under these circumstances the flash is short, the streak of lightning no more than an instant's blinding light, and human beings or animals which may have assisted to complete the circuit are instantly electrocuted! When rain does fall, however, the flash may be very long indeed, often appearing to be from dome to zenith, for there is no dependence under these circumstances

upon such conductors, the falling rain conducts from above and from below, from cloud to ground and vice versa, and though casualties do occur during rainfall they are more in the nature of accidents.

It is during "dry storms" that most of the casualties from lightning stroke occur upon the road, carts and horses and travelling ox-wagons being fairly frequently struck, killing some, stunning others of the occupants as well as the horses, or running along the trek-chain of the wagon, killing or stunning the oxen on each side of it. In other cases, when rain has left the cloud but not yet reached the earth, lightning appears to outrun its conductor when near the earth and will then strike along the current of heated air left behind by the sweating horses or oxen, finding this warm current a better conductor to earth than the surrounding air.

Only one instance of a travelling motor-car being struck by lightning has come to my notice, though they leave a long and more highly-heated current of air behind them as they travel. I think it possible that they more often conduct lightning to earth than their occupants are aware of, as, being of iron or steel, the body of the car may, especially if wet, distribute the electric fluid to earth upon its external surface unnoticed by those travelling in it. In the instance which came to my notice, a car was travelling in a rather crowded street during a thunder-storm, when a flash of lightning fell in the vicinity and appeared to splash off a neighbouring house veranda on to the car just above the wind-screen; the driver holding the wheel was aware of no sort of shock, but upon stopping the car at once and making an examination evidence was found in a fresh streak over the varnish, running down the wind-screen, front and bonnet of the car to the wheel on that side. In view of the large numbers of motor-cars now on the roads and the extreme rarity of any reported instance of a car being struck, it is probable, I consider, that motor-cars are far safer to travel in, during a thunder-storm, than any other vehicle. In the same manner is the lightning distributed over the corrugated iron roofs of our houses and conducted to earth by the water-pipes connecting with the guttering. Though I have seen house roofs struck, and examined several others which had recently been struck, I am not acquainted with any instance where more than trivial damage was done, and probably for this reason.

It is wiser when walking over the veld—perhaps with a gun—or travelling in a cart and overtaken by a thunder-cloud which refuses to precipitate its contained rain, to lie flat upon the ground so as not to offer conduction of earth electricity to the cloud; but such is the indifference bred of familiarity with these storms, and by perhaps long immunity, that few travellers will take this trouble, rather risking the possibility of being struck and getting along. Flammarion, in his book upon lightning, mentions just such an instance. A number of peasants were hoeing in a large field when they observed thunder-clouds arriving overhead, and as rain did not begin to fall all hurriedly left the field, except one old man who was lame; knowing that it would take him some time to reach safety, he dropped to his knees where he stood, and knelt in prayer while the storm passed over him, and in this position was struck by a flash of lightning. When the storm had passed the labourers returned to find the old man still kneeling in the same position, but upon one of them laying a hand upon his shoulder he fell forward, and was found to be dead.

When a man is struck the lightning is readily conducted to earth by his clothes if they are thoroughly soaked and streaming with water, but if he is sheltering beneath a tree, for instance, and his clothes not really wet, the moisture on the surface of his skin and the fluid blood in the capillaries of the skin offer the next best ready conduction to earth; in the latter case streaks and arborescent patches in the track of the electric fluid to the ground, caused by charring of the epidermis and slight scorching of the cutis vera beneath, are very characteristic of lightning stroke; the clothes, socks and boots are invariably burst off from his body, and have the appearance of having had a very blunt knife inserted and its edge dragged through from within out with considerable force. The streaks are red at first, upon a white skin, but soon become brown, the parts feeling stiff and sore for some days but healing without scarring before long. The arborescence is of course much more readily appreciated upon a white than upon a black skin.

A native convict was discharged from jail one morning early, and dressed in a coat and trousers, carrying a stick and a rolled blanket, blithely started for his kraal about two days away. Next morning his body was found beside a path about eight miles from the town, it was thought with appearances of a struggle about him. Totally unaware of the cause of death, and forgetful of a smart thunder-storm which had passed over the town the previous afternoon, I visited the body, to find the coat ripped from his back and trousers from his legs in characteristic manner, whilst a mere glance at the surface of his skin revealed the arborescent burns down one side of the face and at intervals down his trunk and limbs. He had been struck by lightning the afternoon before.

But rarely there are other and far more severe injuries produced by the terrific discharges emanating from overcharged clouds; thus the dome of the skull is sometimes driven in and a gaping aperture with great disorganization of the brain produced, as with a blow of tremendous and concentrated force; other parts of the body have been described similarly broken up and destroyed where struck by this form of lightning.

A man ploughing in heavy rain was struck on the back of the head by lightning whilst thus engaged and, though rendered insensible for many hours and permanently deafened in one ear, recovered otherwise completely *because his clothing was soaked and streaming with wet at the time* and conducted the electric fluid quickly over its surface to the ground. He fell insensible when struck, the horse with the plough wandering back to the homestead alone; carried to the house, after some six hours he was given gr. v. of calomel—shaken dry between his teeth

and washed down with a few spoonfuls of water—the bowels acting vigorously an hour or so later, and in a few minutes he opened his eyes and looked around. It was some time before he spoke, but when seen some hours later still he was able to talk coherently. The back of the hat he wore showed an irregular break, the edges of which were slightly burned, and from the back of the head in this situation a streak of superficial burn was seen to run down the back of his neck, but from here the electric fluid mostly ran down outside his clothes, conducted by the water streaming down them at the time; they were not burst or broken, as usually seen when lightning travels beneath them upon the sweating surface of the body, but wherever metals were worn or carried in the pockets the electric fluid appeared to have struck in through the clothes and produced superficial burns immediately beneath them, e.g., beneath each metal stud and button worn, the buckle of his belt and of each brace, the catch of his sock-suspenders, a knife in one pocket and a key in another. He was somewhat somnolent and stupid for some twenty-four hours more but appeared to recover, with the exception of the hearing referred to and which remained the same many years later, though his brother declared that he was never quite the same as before the stroke.

Remedial Measures.

No more than has already been said can be recommended as a preventive measure for the guidance of those anxious and willing to avoid the risk of lightning stroke, but it should never be forgotten that in most cases it is possible to resuscitate an insensible person who has been struck, by ordinary artificial respiration and brisk rubbing of the body and limbs to set the circulation going again; for the heart, like other muscles, is instantly contracted very firmly by the electrification, and may so remain for a considerable time until *forcibly* distended by the blood again being pumped into it from the lungs and body. A condition of stasis of the circulation exists at this time, and during the period of insensibility there is much suffusion of the face, pointing to feebleness of the circulation from an exhaustion which is probably both nervous and muscular. Many times those struck and apparently quite dead have been thus revived, and excellent work achieved by volunteers in numerous relays. It is recognized treatment also to give a few grains of calomel during the insensibility stage; it acts satisfactorily, probably by stimulating rather violent peristalsis, and in some such way assisting in the recovery of the circulation in the abdomen, for the suffusion of the face diminishes soon after the calomel has acted well.

The Extraordinary Effulgence of Lightning.

Travelling home one night, in a cart with mules, it became pitch dark from an impending thunder-storm; some eight miles had still to be travelled, and anxiety was felt as to whether the distance would be covered before the storm fell; suddenly the road was lit up by a distant but exceptionally vivid flash of lightning, which so illuminated the country-side that the mules stopped dead as though blinded, and it was some minutes before I was able to proceed. That flash had come to earth over thirty miles away and was the first flash seen before the storm broke. Where it fell seven men were crowded into a bell-tent, to the pole of which, high up, was lashed a bicycle; the tent was struck at its point, bursting a large hole in it and running down its pole to the ground, the electric fluid creating terrible havoc; some of it splashed off the bicycle into the faces of the men, immediately and totally blinding some of them by burning their corneæ, killing three instantly and burning them all severely about the body; mercifully most of them were dead when found next day, but one man survived who is totally blind and has remained so now for a number of years.

During the Boer War, and whilst resting in a tent one afternoon, the nearness of an impending thunder-storm was advertised by the thump of a few great drops of rain upon the canvas; hastily kneeling up to the canvas I was about to let down the lower fringe of curtain when a very vivid flash of lightning came to earth about 200 yards away and exactly opposite me as I knelt; in the second or less during which the incandescence of the flash lasted the side of the tent was perfectly transparent, as though swept from before me, and I saw through it the flash fall amongst a group of soldiers, throwing them apart like chaff! Upon hurrying straight to the spot, three of the soldiers lay insensible, whilst one, who had been standing, leaning upon a rifle with fixed bayonet, and who was seen to be struck, was killed. Artificial respiration resorted to at once resuscitated the three after a considerable time and many relays of men; they all ultimately recovered completely, but no less than nine other soldiers were more or less splashed and burnt by the electric fluid. There was evidence that the rifle held by the man killed was struck first, and that the lightning travelled from it along his arms and entered his chest, for his injuries in this region were very severe.

The extraordinary effulgence of lightning, its extreme brilliance whilst it lasts, is seldom so astonishingly brought home to one as in this instance; it is produced by the instant incandescence of the air through which the electric fluid speeds at such terrific momentum and, owing to particles of dust in the air, is always most vivid when it falls, before the rain descends, through comparatively dry air.

Mycetoma. Report of four Cases (E. D. Lovejoy and R. W. Hammack, *Arch. of Dermat. and Syph.*, January, 1925).—Mycetoma is more common in the south-west of the United States than in other parts. It occurs most often in Mexicans, probably because of habits and occupation. There is comparatively little variation in the clinical and pathological picture, in spite of the fact that the causative fungi vary greatly. These four cases bring the number of mycetoma cases reported in the United States up to nineteen.

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A WHITE AUSTRALIA: IS IT A POSSIBILITY?

By SYDNEY J. SKERTCHLEY, J.P.

(*Continued from page* 114.)

CHAPTER IX.

Australia.

(167) We must now apply the results of our investigation to the land of our adoption, Australia. We have reviewed the story of the human race from prehistoric times to the present day, looking upon it from an anthropological and not a political point of view, and have been driven to a remarkable conclusion. It has been shown that there is no evidence that either the Fair Whites (who alone concern us) or the Dark Whites, have ever succeeded in permanently establishing themselves on any foreign soil, with the doubtful exception of Canada. It is puerile to prattle about there not having been time enough to adequately test the question—we have been testing it from those dim ages when the elephant trumpeted in the glades that overlooked old Father Thames, in whose waters the hippopotamus wallowed, and where our forebears attacked the monsters with stone axes. We have seen the power of Imperial Rome succumb to the Fair White till all Europe owned his sway, and we have found in each and every case the autochthonous race—the man of the soil—come to his own again. This cry of "Give Australia time enough" is but the cuckoo-babble of ignorance. He who will not learn from experience can learn from nothing.

(168) In North America we have the finest object lesson of the age, and it is some four centuries old. In that great land, the land of splendid distances and splendid achievements, we see that the Fair White has not held his own, and that the future of the United States is by no means a certainty along the Anglo-Saxon lines that have led to greatness. The old Puritan and Dutch blood which gave the initial stamina is dead or decaying, and is being fast replaced by the less virile blood of the Dark White and the Slav, who, themselves, if we may judge by their history in the south, will in turn become enfeebled. I had been driven to this conclusion independently, and was surprised to find how keenly alive some of the best Americans were to the unpleasant fact. I had seen moribund Spain in the Far West and the Far East—the problem was not merely academic with me, though my studies had led me into academic grooves. My professional work had lain for years along anthropological lines, and in addition a longish line has been spent wandering to and fro upon the earth—like another great personage. The result was painful, but that I could not help. Had I been able to come to any other conclusion I would have gladly done so; but facts were too many for my patriotic belief in my race. The case of the United States determined me to review in detail the whole of the evidence, with the results now being set forth. The climax was, of necessity, the application of my studies to Australia.

(169) Through the kindness of Mr. Thornhill Weedon, the Queensland Government Statistician, I was enabled to work out the details of that State, and I had completed this—my last article—when the "Official Year Book of the Commonwealth of Australia" for 1901-8 appeared. I found Mr. G. H. Knibbs, the Commonwealth Statistician, had dealt with the question of the population of Australia in a masterly manner, and curiously had taken the United States for comparison of the natural increase. This welcome and independent addition to my subject

necessitated the re-writing of my article, and hence the delay in publication. It is no pleasant task to cry "Woe, woe to the city," or even "Wolf," and I suppose Priam and Hecuba snubbed Cassandra as a vapouring schoolgirl—yet Troy fell. I don't wish to be a trousered Cassandra, but I needs must show that "Australia for the Australians" is rather an aspiration than a probability.

(170) I will deal with Australia under three aspects. First, the natural rate of increase; second, Tropical Australia; and third, Urban Australia, that is, the effect of centralization.

Chapter X.

Components of Australian Population.

(171) The census of 1901 gave the population of Australia, with Tasmania, as 3,773,801, of which 2,908,801 were of Australian birth. The percentage of population according to birthplace for the Commonwealth was:—

	Per cent.
Australia	77·23
New Zealand	0·68
United Kingdom	18 03
Rest of Europe	1·98
Asia	1·25
Africa	0·08
America	0·33
Polynesia	0·28
At Sea	0·14
Total ...	100·00

We have therefore in the Commonwealth, a typically Australian population, the British-born numbering 679,159, as against 2,908,303 "Australian natives," as they proudly and justly dub themselves. But we have more than this: the population is essentially Fair White, and so eminently adapted for our investigation. As Mr. Knibbs puts it, "For the Commonwealth as a whole 98 per cent. of the population were from Australian or European birthplaces." (All quotations in this article, unless otherwise specified, are from Mr. Knibbs' "Official Year Book.") The Dark White population is so insignificant as to be negligible, amounting only to 0·008 per cent. Australia is, therefore, an even better test case than the United States in the investigation of the problem as to whether the Fair White race can permanently occupy a region foreign to that of their origin.

(172) The increase of the population of the Commonwealth since records have been kept is as follows:—

1788	857
1800	7,707
1810	15,063
1820	52,505
1830	70,039
1840	190,408
1850	405,356
1860	1,145,585
1870	1,647,756
1880	2,231,531
1890	3,151,355
1900	3 765 339
1907	4,197,037

Annotations.

The Treatment of Psoriasis by Intravenous Injections of Salicylate of Soda (J. Ferguson Smith, *Brit. Jour. of Dermat. and Syph.*, January, 1925).—Intravenous injections of sodium salicylate caused the disappearance of the eruption in sixteen per cent. of fifty-seven cases of psoriasis, its almost complete disappearance in eighteen per cent., and its distinct amelioration in fourteen per cent. Fifty-two per cent. were either unimproved or worse. Provided the dose did not exceed 3·0 gm. no unpleasant effects were noted. Exfoliative dermatitis ensued in six per cent. of the cases. Its connection with the treatment is uncertain. Several difficult cases, including one which had resisted a great variety of measures, were cleared by this means. While unsuited by the high percentage of failures and the necessity for frequent attendance for routine use, the method seems worth a trial in selected difficult cases. No evidence has yet been obtained as to its power of preventing relapse. It is advisable to combine the injections with local treatment, which was omitted in this series solely in order to evaluate the injection method.

Granuloma Inguinale: Including a Series of Cases illustrating some Points in Prognosis and Treatment (A. R. Fraser, *Brit. Jour. of Dermat. and Syph.*).—Eighteen cases of granuloma inguinale are summarized. Of these tartar emetic was employed in sixteen. Six cases healed completely. In ten cases there was no benefit from the intravenous use of the drug. In one case tartar emetic was not employed, and in another the condition healed after the administration of sulfarsenol. In no case was the rapid healing following intravenous tartar emetic, reported by some workers, observed. The prognosis in this condition is always grave as regards prospects of healing. There is no danger to life, and little impairment to general health. Intercurrent disease frequently makes headway on account of lowered resistance on the part of the patient. If the lesion is confined to the penis there is always a serious risk of the whole organ being completely destroyed. When this unfortunate state is reached the disease invariably becomes quiescent, and, although further spread does not occur, complete healing never takes place. The statement that the disease tends to spontaneous healing is without foundation. Treatment is most unsatisfactory.

Amœbiasis Cutis. With a Survey of the Medical Literature to Date (L. F. Heimburger, China, *Arch. of Dermat. and Syph.*, January, 1925).—Amœbic infection of the skin is extremely rare; few cases have been recorded in the literature. An interesting case is described by the author, in a Chinese farmer, aged 39. Patient first complained of a large ulcerated area in the right loin, painful; discharged large quantity of brownish-coloured

pus with a putrid odour. An interesting factor in this case is the rupture of the abscess externally through the abdominal wall. The growth of the ulceration was comparatively slow. The marvellous rapidity with which the emetin acted when given in sufficient dosage, is worthy of note, even in tissues in which the blood supply is greatly interfered with by the embolic action of the amœba. With drastic treatment with ordinary antiseptics (forty-nine per cent. liquor formaldehydi) the viability of the amœbæ was not noticeably affected. Emetin treatment by hypodermic injection in sufficient quantities is a specific for this disease.

Leprosy in New York City (J. A. Fordyce and Fred Wise, *Arch. of Dermat. and Syph.*, January, 1925).—Cases of leprosy in New York are not few; being a seaport town, many persons with leprosy gain access to the country and the disease is not always detected by the port authorities on account of its long incubation period. In the majority of cases the incubation period is a matter of years. The disease is evidently a contagious one. A table is given showing some data on forty-seven patients with leprosy. There are thirty-seven males and ten females. Youngest, a girl of seven; oldest, a woman aged fifty-five. There were twenty-nine white persons, eleven mulattoes, six Chinese, and one negro. Only three gave their birth-place as the United States, the rest were from different parts of the world. Fourteen patients had maculo-anæsthetic leprosy; eleven the nodular type, and twenty-two the mixed type. The photographs which accompany the article illustrate the early or more active phases of the disease.

A Study of the 1923 *Epidemic of Anterior Poliomyelitis in Kansas. Preliminary Report* (R. L. Diveley, *Jour. Amer. Med. Assoc.*, January 10, 1925).—From the study of this epidemic of anterior poliomyelitis, the cases over a period of one year having been followed, the following conclusions seem justifiable. If an early diagnosis is made, and proper treatment instituted during the febrile stage, the resulting cord involvement is not only lessened, but in a great percentage of cases prevented. If proper treatment is carried out during the second or convalescent stage, from seventy-five to eighty-five per cent. of the cases will show marked improvement or complete recovery, against forty to forty-five per cent. of partial recovery if proper treatment is not carried out. If proper treatment is carried out during the first and second stages, fully ninety per cent. of the deformed limbs and backs can be prevented. Many cases recover spontaneously without treatment, while others still show signs of paralysis after one year of careful supervision.

Some Morphological Features of Plasmodium falciparum (J. W. W. Stephens, *Annals of Trop. Med. and Parasitology*, April 30, 1924).—Microscopical examination of stained films, from a case admitted to hospital in West Africa, showed numerous *P. falciparum* parasites and a very scanty crescent infection. The red cell infection rate was approximately one per cent., and the relative numbers of single and multiple infections were: single, sixty-nine per cent.; multiple, thirty-one per cent. A more prolonged examination of these films revealed many peculiar forms, some of which are figured diagramatically in this paper. These forms were somewhat uncommon, but could always be found by systematic search through the films with a mechanical stage. They are arranged in four groups: (*a*) those in which there is a cytoplasmic connection between two adjacent parasites; (*b*) those in which there is a nuclear connection between two adjacent parasites; (*c*) symmetrical parasites; (*d*) miscellaneous forms.

The Crescent and the Red Cell (J. W. W. Stephens and R. M. Gordon, *Annals of Trop. Med. and Parasitology*, August 2, 1924).—The observations described were made on a series of thin blood films from a case of malaria in the Federated Malay States. Attention is drawn to the variable relationship existing between the crescent and the red cell. Illustrations of the forms accompany the paper, and are divided into four groups, i.e.: (*a*) those in which the red cell stains uniformly, presenting a solid appearance; (*b*) those in which the red cell is partly decolorized; (*c*) those in which the greater part of the red cell is decolorized and in which part of the circumference of the red cell takes the form of a loop, usually corrugated and generally subtending the concavity of the crescent; (*d*) miscellaneous forms.

On "Orchidoma" or "Orchidoblastoma" of the Horse (Tetsuji Kimura, *The Sei-I-Kwai Med. Jour.*, December, 1924).—The occurrence of tumours among the slaughter cattle in Japan is chiefly observed in horses, and melonoma and tumour of the testis are the most frequently met with. Tumours of the testis among horses are almost all so-called "orchidoma" or "orchidoblastoma," being found mostly in stallions of fifteen or more years of age, and usually only one testicle is involved. From the results of the macroscopical and microscopical examinations it can be seen that these tumours arise from the cell-proliferation in the seminiferous tubule, and belong to the epithelial new-growths (epithelioma). Metastasis in spermatic cord, inguinal and lumbar lymph-nodes is frequently to be seen, and always occurs through the lymph vessels.

Tuberculosis Incidence and Climate in India: Rainfall and Wet Winds (Sir Leonard Rogers, *Brit. Med. Jour.*, February 7, 1925).—The direction, steadiness, and strength of the rain-bearing winds appear to be the most important factors, in addition to high rainfall and absolute humidity, in influenc-

ing the prevalence of pulmonary tuberculosis in Indian jails. These observations are in accordance with the well-known observations of Dr. W. Gordon, of Exeter, on the relation between exposure to humid winds in Devonshire and the incidence of phthisis, and afford them strong support on a very large scale, since the monsoon-influenced Ganges and Upper Indus valleys extend over 1,400 miles. Their bearing on the choice of a residence for an actual or potential phthisical patient, and on the choice of sites for sanatoriums, is obvious.

Cutaneous Gonococcal Infection (A. Neave Kingsbury, *Brit. Med. Jour.*, February 7, 1925).—A medical man consulted Dr. Kingsbury on account of a curious dermatitis of the elbow. A slight abrasion was caused by a fall while playing football, and a week later the lesion became acutely inflamed and painful. On examination the abrasion was found to have become a shallow ulcer. Encircling the ulcer were a number of bullæ. The axillary glands were large and tender. Serous fluid was obtained by the aspiration of one of the bullæ, and films showed a few pus cells with intracellular Gram-negative diplococci morphologically resembling gonococci. A few Gram-positive cocci were also present. From cultures on blood agar *Staphylococcus aureus* and a Gram-negative diplococcus were obtained. Colonies of the latter on serum agar developed the scalloped edge characteristic of gonococcal colonies after four days' incubation. No history of gonorrhœa. Fermentation tests proved the organisms to be the gonococcus. Inquiries as to the probable source of infection elicited the fact that three days before the elbow became painful the patient had operated on a female for elephantiasis. At the time of operation there was vaginal discharge, but subsequent examination failed to detect any gonococci.

The Relative Number of Male and Female Crescents (J. W. W. Stephens and R. M. Gordon, *Annals of Trop. Med. and Parasitology*, April 30, 1924).—In this case, observed by the authors on nine separate days, female always outnumbered male crescents, the average ratio being three to one.

On Orchitis of the Rabbit, Experimentally produced by Inoculation with the Spirochæte of Rat-Bite Fever (S. Takenaka, *Acta Dermatologica*, November, 1924).—This paper gives a brief report of the clinical and histological features of the orchitic change in the rabbit induced by the injection of the spirochæte of rat-bite fever into this organ, whereby the specific inflammation takes place in each instance without fail, running a much shorter but much more regular course than that of the experimental syphilitic affection of the same animal. The spirochæte originated from a human case of rat-bite fever, and was transmitted from mouse to mouse in succession through many generations—passage virus. The process affects the testicle tissue uniformly. The course, being quite regular, can be divided into four stages: first week, incubation; second week, the stage of active progression; third week (or a few days more; the process may be prolonged into the fourth week), the stage of regression; fourth-fifth week, the œdematous swelling of the prepuce (and the perianal region) is a syndrome frequently observed.

The Production and Significance of Cutaneous Allergy to Pneumococcus Protein (G. M. Mackenzie and S. T. Woo, *Jour. of Exper. Med.*, January 1, 1925).—Intracutaneous injection of guinea-pigs with an alkaline extract of pneumococcus produces in about two-thirds of the animals an allergy with a skin reaction similar to the allergic skin response of tuberculosis. Continuance of the intracutaneous injections after the appearance of allergy results in its disappearance. The skin ceases to react. Neither of the animals manifesting skin allergy, nor those which fail to develop it, show any significant alteration in susceptibility to pneumococcus infection by intraperitoneal inoculation. Similarly, animals desensitized by continuing the intracutaneous injections after the appearance of allergy show an unaltered susceptibility.

The Significance of Anaphylaxis in Pneumococcus Immunity (G. M. Mackenzie, *Jour. of Exper. Med.*, January 1, 1925).—Intraperitoneal injections of killed and living broth cultures of a virulent pneumococcus produce in guinea-pigs a high degree of active immunity and a serum with strong protective power. Despite the protective power of such serum, no agglutinins for the homologous organism and no precipitins for soluble derivatives were demonstrable. Guinea-pig immunity to pneumococcus infection produced by the method described is not attended by cutaneous allergy to derivatives of the pneumococcus used for immunization. During the course of an artificially produced active immunity, anaphylaxis may at times be present, and at times absent, without any measurable effect upon the resistance of the animal to infection by intraperitoneal injection. In the particular instance studied, the experiments indicate that anaphylaxis to pneumococcus protein has no important effect upon the resistance of the animal to infection. It appears to be a concomitant without any significant rôle in the immunity mechanism.

Encephalitozoon Cuniculi as a Kidney Parasite in the Rabbit (T. Smith and Laura Florence, *Jour. of Exper. Med.*, January 1, 1925).—A spontaneous epidemic of nephritis among rabbits, associated with a protozoan parasite, has been observed in a certain breeding stock since 1918. It is regarded as a nest

infection. The parasite is tentatively classed among the microsporidia and the stages encountered are regarded as vegetative, which may, perhaps, pass through several generations in the same host. It is a parasite of the epithelial cell, provoking no immediate host reactions. These are supposed to follow injury, such as the destruction of the epithelium and denudation and plugging of the tubules. The localizations in the brain are also without cell reaction, except under special conditions, and the many cell foci present are attributed to coccidia and perhaps to bacteria and other intestinal parasites. The kidneys are looked upon as the normal habitat and the brain parasites as aberrant and outside the normal cycle, unless it can be shown that the spores discharged into the circulation may again multiply in some organ like the kidneys in direct communication with the exterior. It is highly probable that many reported cases of nephritis among older rabbits used in experiments had their origin in an early invasion of the parasite described.

Serological Relationships among and between the Streptococci and Pneumococci (C. H. Hitchcock).—Using the complement-fixation reaction with whole bacterial solutions as antigens, it has been possible to confirm the existence, within the non-hæmolytic streptococcus family, of two great groups. One of these groups, that which may be designated as of the left side, is related in an orderly way to the hæmolytic streptococci; the other, of the right side, is similarly related to the entire pneumococcus family. In addition, the hæmolytic streptococcus family shows a reactive range which relates it, though less closely, to the non-hæmolytic streptococci of the right side, and to the pneumococci. The existence of these cross-relationships is not associated with the precipitable substance of either family, but may tentatively be presumed to be dependent upon the properties of the protein or lipoid-protein fraction of the bacterial cell.

Malaria in Suriname (C. Bonne, *Nederl. Tijdschr. v. Geneesk.*, August, 1924).—In Dutch Guiana all three species of malarial parasites are found and ten known species of anopheles. Subtertian malaria is the commonest form in the hills, and the chief insect host is *A. argyrotarsis*. This parasite is not found on the coast, but *A. tarsimaculatus* may be seen. Fifty-four per cent. of the nigger children and twenty-four per cent. of adults are infected. Fifty-six per cent. of the black miners are infected. Malaria was much less prevalent in 1922 than 1921. Ten cases of blackwater fever have been recorded during these years.

Factors concerned in the Polycythemia produced by the Subcutaneous Injection of Epinephrine (C. W. Edmunds and E. E. Nelson, *Jour. of Exper. Med.*, January 1, 1925).—The subcutaneous injection of epinephrine in doses of 1 mg. per kilo brings about a polycythemia, an increase in reticulocytes, and an increase in young forms of polymorphonuclear leucocytes. The polycythemia is no doubt in part a concentration phenomenon, but the presence of these young cells in increasing numbers is believed to be evidence that there is at the same time a discharge of cells from the blood-forming organs, due to the effect of the drug upon them. A similar effect is obtained by continued stimulation of the peripheral ends of the cut sciatic nerves in the curarized animal.

The Alleged Rôle of Lactic Acid in Arthritis and Rheumatoid Conditions (F. A. Cajori and C. Y. Crouter and R. Pamberton, *Arch. of Internal Med.*, October 15, 1924).—The lactic acid contents of the blood, urine and sweat of patients suffering from arthritis and rheumatic disabilities has been determined, and the results have been compared with the respective lactic acid contents from non-arthritic persons. The lactic acid was determined also in the synovial fluid from a case of joint effusion. In no case have abnormal quantities of lactic acid been observed in the arthritic patients. These findings, therefore, lend no support to the idea that arthritis, at least of the types studied, is caused or characterized by abnormal production or disposal of lactic acid. Lactic acid has been found to be present in sweat in considerable quantities, making up about fifty per cent. of the organic acids of sweat. Its presence in this secretion may be referable to the chemical changes occurring in the sweat glands during their activity. The benefit accruing to arthritic patients from sweating measures cannot, in the light of these results, be ascribed to the elimination of lactic acid in the sweat.

The Concentrating Capacity of the Kidney (T. Addis and M. G. Foster, *Arch. Internal Medicine*, October 15, 1924).—Experiments on normal human subjects are reported in which the conditions were adjusted with a view to the production of urine which would contain the highest possible concentration of urea, chlorids and phosphates. It was found that the highest concentration of each of these substances was attained when it was given in considerable amount and in high concentration to subjects whose fluid intake had been restricted. Experiments on rabbits deprived of water and given large amounts of a mixture of urea and sodium chloride showed that it was possible to obtain urine in which there was a high concentration of both these substances. No evidence was found which would suggest that the height to which the osmotic pressure of the urine might rise is restricted by virtue of any limitation in renal capacity. The widely accepted hypothesis that the kidney is unable to excrete urea, chlorid or phosphates at more than certain maximum concentrations is shown to be

untenable. The assumption that concentrations of urea, chlorid and phosphates, which approach the highest levels found in the urine, have approximately the same osmotic pressure is shown to be contrary to observed facts. It is suggested that changes in the concentration of urea, chlorids and phosphates in the urine are produced by changes in the relation between the concentration of these substances in the blood and the concentration of free water in the blood. It is difficult to obtain very high concentration of the urine because a marked increase in the concentration of urea, chlorid or phosphate in the blood is associated with a concomitant increase in the concentration of free water in the blood.

On the Accuracy of Measurement of Small Volumes of Fluid with a Capillary Pipette (A. Fleming, *Brit. Journal Exper. Path.*, 1924, vol. v, page 148).—It has been shown that measurements of five and ten cubic millimetres can be made with ordinary capillary pipettes with more than sufficient accuracy for use in the ordinary serological work of a bacteriological laboratory. The wash—that is the amount of fluid which adheres to the inner wall of the pipette—amounts to, at the ordinary rate of working, about three per cent. of the volume measured. In making a series of dilutions in the ordinary way, the fact that a wash about three per cent. remains in the tube introduces a progressively increasing error of about 1·5 per cent. with each dilution, so that at the eighth dilution the theoretical error would be about 13 per cent. A pipette is described whereby a series of dilutions can be made rapidly, and in which the error due to the wash can be eliminated.

The Reaction of the Liver to Phenol-tetrachlorphthalein in Early Obstructive Jaundice (W. Bloom and W. H. Rosenau, *Arch. of Internal Medicine*, October 15, 1924).—In the absence of the liver and kidneys, phenol-tetrachlorphthalein continued to circulate in the blood-stream. The intravenous injection of phenol-tetrachlorphthalein in the early stages of obstructive jaundice in dogs caused an early appearance of both the indirect and the direct Van den Bergh reactions that was noticed in control animals. All attempts to recover the dye from the liver in obstructive jaundice were unsuccessful. Dog liver decolorized phenol-tetrachlorphthalein less than the heart, lung and spleen *in vitro*. In early obstructive jaundice phenol-tetrachlorphthalein appeared in minute amounts or not at all in the lymph of the thoracic duct. In chronic obstructive jaundice, however, the dye was present in large amounts in the lymph of the thoracic duct. The intravenous injection produced in the human being a transient hyperbilirubinemia, as evidenced by the Van den Bergh test. The high incidence of thromboses and other untoward reactions after the injection of phenol-tetrachlorphthalein is a serious objection to the execution of this test as a clinical method. In no case of long standing complete biliary obstruction have we noticed a greater dye retention than four per cent. in the blood-stream. A new method is given for the accurate determination of small amounts of phenol-tetrachlorphthalein in blood-serum.

Detection of Traces of Alkali or Soap in Refined Coconut Oil (W. L. Brooke, *Philippine Journal of Science*, August, 1924).—Less than 0·02 per cent. sodium carbonate can be detected in twenty-five grammes of coconut oil by ashing and testing with phenolphthalein. As small an amount as 0·00065 per cent. sodium hydroxid can be detected in twenty-five grammes of coconut oil with certainty by ashing. A nickel crucible is preferable to a porcelain crucible for ashing.

Chemotherapeutic Experiments with Chaulmoogra and Allied Preparations (Otto Schobl, *Philippine Journal of Science*, August, 1924).—The degree of unsaturation of vegetable oils which stimulate the growth of acid-fast bacteria and of those which inhibit the growth of acid-fast bacteria has no relation to their growth-stimulating or growth-inhibiting activity. The growth-stimulating effect of certain vegetable oils is due to the glyceryl and not to the acid part of the oil. The condition of the unsaturation of the oils containing the acids from the chaulmoogra series and of the oils which stimulate the growth of acid-fast bacteria is paramount. Saturated chaulmoogra oil lacks the growth-inhibiting activity toward acid-fast bacteria which is possessed by the unsaturated oil. The growth-inhibiting activity of chaulmoogra oil depends on the structure of the ring of the fatty acids. When the structure of the ring is changed by saturation with hydrogen the oil loses this biologic property. There are indications that, due to physical properties, acids from the chaulmoogra series containing a short side-chain are more effective *in vitro* than are those having a long side-chain. Acid-fast bacteria adapt themselves to the acids from the chaulmoogra series in due time and then withstand larger doses than they did originally.

The Concentration of the Plasma Proteins in Nephritis (G. C. Linder, C. Lundsgard and D. D. Van Slyke, *Journal of Experimental Medicine*, vol. xxxix, No. 6, June, 1924).—In nephrosclerosis (Volhard and Fahr classification of nephritis) there was no decrease in the plasma proteins. With heart failure the ratio of albumin to globulin fell from the normal 1·7-0·3 to about one.

There is a sharp difference between the two types of glomerulonephritis in the effect on plasma proteins. In the vascular-interstitial type the effect was

the same as in nephrosclerosis. There was no decrease in the plasma proteins until shortly before death.

In the glomerulo-tubular or nephrotic type, active or recently active, the total plasma proteins were less than 5 gm. per 100 c.c. This decrease from the normal 5·5 to 7·5 occurred whether œdema was present or absent. The decrease chiefly affected the albumin, the globulin being usually diminished but little, and sometimes slightly increased. Consequently the ratio of albumin to globulin was reduced to less than one, and occasionally to 0·6.

In nephrosis similar conditions were found in the protein concentration, but in severe cases the decrease in albumin was greater than in nephrotic glomerulonephritis, while the globulin was either very slightly reduced or was increased. The albumin globulin ratio was therefore lower than in nephrotic glomerulonephritis, ranging down to 0·26.

With the disappearance of œdema there was usually an increase in the plasma protein concentration, but this was not invariable, and concentrations of 4·5 per cent. or less were compatible with the persistent absence of œdema. The ratio of albumin to globulin showed an irregular tendency to rise. Whenever the total concentration was less than four per cent. there was œdema present, but it was sometimes slight in amount.

With recovery in acute cases, and remission with decrease of proteinuria in chronic cases, normal concentrations were regained. The albumin-globulin ratio remained low in some instances for a longer period on account of an absolute increase in globulin concentration.

In " functional proteinuria " no change in plasma proteins was found.

Low plasma protein concentrations were always associated with considerable losses of protein in the urine, but these losses did not provide an explanation for all the observations. A disturbance in the production of the plasma proteins appears probable.

A New Liver Function Test (G. D. Delprat, M. N. Epstein, William J. Kerr, *Archives of Internal Medicine*, October 15, 1924).—In normal persons, following the injection of a given amount of rose Bengal into the circulation, the concentration of the dye computed under standard conditions of dosage and blood volume does not exceed certain limits at four and eight minutes after the time of injection. In abnormal cases, where evidence of liver disease can be demonstrated clinically, the concentration of the dye in the circulation computed under standard conditions of dosage and blood volume at four and eight minutes from the time of injections, exceeds the limits of concentration of the normal cases. Complete biliary obstruction which can be determined by other clinical tests, causes a retention in the blood-stream. When it can be shown that the rate of elimination of rose Bengal from the circulation, after injection is reduced, or, in other words, when the concentration of the dye at four and eight minutes after injection exceeds the normal limits, a certain degree of liver dysfunction may be assumed to exist in the absence of complete biliary obstruction. A rough estimate can be formed from the concentration of the dye remaining in the circulation at four and eight minutes after injection, of the extent of the liver disease.

Multiple Electrical Stethoscope and Electrical Filters as Aids to Diagnosis. Phonograph Records of Heart Murmurs (C. J. Gamble, M.D., *Journal of American Medical Association*, October 18, 1924).—Further improvements have been made in the multiple electrical stethoscope. Electrical filters permit selection of the components of a sound above or below a chosen pitch, a procedure not possible in other methods of auscultation. This is of advantage in the magnification of lung sounds and murmurs, and the detection of pericardial rubs and fœtal heart tones. Phonograph records of heart murmur and breath sounds, of a quality satisfactory for teaching, have been made and demonstrated to a large audience. With a small attachment they may be reproduced on an ordinary phonograph. Marked progress has been made in the reproduction of chest sounds by a loud speaker.

Report on the Investigation of a number of Cases of Leprosy at Nauru, Central Pacific (F. G. Morgan, *Commonwealth Department of Health Service Publication*, No. 25).—Nauru is a small, very isolated island in the Central Pacific Ocean. The Nauruans are an attractive, happy people, well nourished and well developed. Their food is mainly raw fish and coconuts. The climate is equable, extremes of heat and cold do not exist, and there are no seasons. Since 1920, thirty-nine known cases of leprosy have occurred upon the island. Of this number, thirty-seven were Nauruans, one a Chinese, and one a Caroline Island native for many years resident on Nauru. A few sporadic cases have occurred amongst the Chinese labourers from time to time previous to 1920. A Gilbertese woman, Etsio, was probably the source by which the disease was introduced to the Nauruans between the years 1911 to 1914. Since leprosy has a prolonged incubation period, it is to be expected that further recognizable cases will appear as the disease develops, while at present they show no recognizable signs of the malady. The recently introduced method of regular medical inspection of the total population, combined with prompt segregation of lepers, will do much towards stamping out the disease. Routine nasal swabbing was of little value in detecting incipient cases of leprosy. Acid-fast bacilli were detected in the nasal secretions in two cases out of twenty-nine known lepers, and were not found in any case not otherwise demonstrated to be leprous. It appears that smears made from tissue excised from suspicious lesions is the best method of demonstrating acid-fast bacilli.

This is by no means infallible, but supplies useful confirmatory evidence. Most of the patients were in an early stage of the disease. A point of interest was the frequency with which the various lesions appeared in different parts of the body, and the frequent and early appearance of macules upon the upper limb, especially between the elbow and the shoulder.

The Wassermann Test. The Effect of Intramuscular Injection of Neo-arsphenamin on the Wassermann Reaction (D. L. Belding and R. H. Holmes, *Arch. Dermatology and Syphilology*, vol. 10, No. 5, November, 1924).—This is the third of a series of papers that discuss the effect of certain antisyphilitic remedies on the Wassermann reaction. The conclusions are that the strength of the Wassermann reaction in congenital syphilis, as a rule, is greater than in acquired syphilis of the same duration. Apparently it is stronger in early than in late congenital syphilis. Children with clinical evidence of syphilis have a stronger reaction than children with only serum-positive syphilis. Children who have received treatment have weaker reactions than the untreated children. Intramuscular injections of neo-arsphenamin appreciably lower the strength of the reaction, at least for sixteen weeks, the period of observation in the authors' cases. Children who give past or present clinical evidence of syphilis and resultant malnutrition respond less readily to treatment than those in whom the disease is latent. Untreated or slightly treated children respond more readily to treatment than those who have received thorough previous treatment, suggesting the development of a treatment-fast condition.

Works on Rabies During the Last Ten Years (P. Remlinger).—The author has condensed the most important papers published within the last ten years on the subject of rabies. The clinical diagnosis of human rabies is not always easy; many of the symptoms may also be seen in other affections and for this reason there have been several erroneous diagnoses.

Effects of Non-Specific Protein Therapy in Syphilis (S. S. Greenbaum, L. Carrol, S. Wright, *Arch. of Dermatology and Syphilology*, vol. 10, No. 5, November, 1924).—This series of cases shows that non-specific protein therapy favourably influences the course of syphilis. In what manner it exerts this favourable influence or what value it has in the treatment of syphilis, the authors are not prepared to say. They emphasize that it is not their purpose to intimate that injections of foreign protein are in any way a cure for syphilis. Their experience, however, would indicate that there is a definite influence on the course of the disease following their use; and this influence, in chronic syphilis at least, appears to be a favourable one. If the effect of the injections is to stimulate the natural protective forces of the body, the use of non-specific protein therapy as an adjunct to specific therapy may be of decided value.

Universal Leukæmia Cutis (H. L. Keim, *Arch. Dermatology and Syphilology*, vol. 10, No. 5, November, 1924).—A case of universal leukæmia is presented with clinical histopathologic and hæmatologic evidence of lymphatic leukæmia From a study of this patient and other cases of leukæmia, mycosis, fungoides, lymphosarcoma and Hodgkin's disease it would seem that these diseases are genetically related pathologically and may be grouped under the head of the "lymphoblastoma." If such a classification is justifiable, then the cutaneous pictures associated with these diseases must be regarded as the variable cutaneous expressions of the "lymphoblastomas."

Scrofuloderma Gummosa (Tuberculosis Colliquativa) (H. A. Michelson, *Arch. Dermatology and Syphilology*, vol. 10, No. 5, November, 1924).—From a review of the literature and his own observations on tuberculous colliquativa (scrofuloderma gummosa) the author is convinced that this is a distinct type of true cutaneous tuberculosis which does not necessarily arise from tuberculous glands or bones, but may begin in the cutis or sub-cutis.

The Calcium Content of the Blood in Various Diseases of the Skin (H. J. Schwartz and O. L. Levin, *Arch. of Dermatology and Syphilology*, vol. 10, No. 5, November, 1924).—These studies are based on an analysis of over 300 cases, which are given in tabulated form, and which show that examination of the blood from patients suffering from various dermatoses does not reveal any positive relationship between the calcium content of the blood and the skin disease. The presence of calcium deficiency was revealed in several cases of acne vulgaris, eczema, furunculosis and folliculitis. The administration of calcium and parathyroid by mouth seemed to produce clinical improvement in some of the patients and enhance the calcium content of the blood. Although normal figures were obtained in urticaria and allied conditions, it is possible that in such instances the tissues may have been unable to take up and use the blood calcium or that there may have been a disturbed colloidal chemistry of the cells. The clinician who is anxious to establish a relationship between abnormal calcium metabolism and skin diseases must, according to the authors, wait for more improved laboratory methods and a better understanding of the whole subject of calcium metabolism.

Diagnostic Errors Leading to Uncalled for Appendectomy (Henry Wald Bettmann, *Journal of the American Medical Association*, October 18, 1924).—Operations for chronic appendicitis do not yield a satisfactory proportion of cures owing to errors in diagnosis. The term chronic appendicitis expresses a pathological rather than clinical condition. The relapsing form of appendicitis necessitates prompt surgical intervention, and yields a very large proportion of permanent cures. Aside from the relapsing type, a particular group of symptoms suggests chronic appendicitis, but not with reasonable certainty. Right iliac pain is a most deceptive sign. In from forty to fifty per cent. of the unsuccessful operations it remains for months or years after the operations. Two thirds of the failures are in cases that have not been adequately studied before operation. Roentgen-ray examinations are usually not to be depended on for clinical diagnosis, and are often misleading. Urinary disorders are far too often mistaken for appendicitis. In general, too many constitutional disorders are overlooked, and appendectomy often has serious after-results

Current Literature.

The Indian Medical Gazette. January, 1925.

The Problem of Epidemic Dropsy and Beriberi (H. W. Acton and R. N. Chopra).—Epidemic dropsy and beriberi are different clinical aspects of a toxic syndrome caused by the ingestion of poisonous bases formed in rice under certain conditions; although similar poisons can be formed in other foods under storage, e.g., tinned provisions, dried fish, &c. This disease in the rice can readily be detected by the water test, and moreover these two clinical entities are associated with two different grades of rice. A spore-forming proteolytic bacillus of the *B. vulgatus* group is commonly found in such diseased grains. Highly polished grain is more easily attacked owing to the loss of the aleurone layer and embryo, and the consequent exposure of the delicate cells of the fruit. The bacteria and their spores as well as their effects on the structure of the fruit, can be demonstrated by microscopical sections and cultural tests. Experimentally by spraying rice or inoculating sterile rice media under certain conditions of temperature and humidity, the same poisonous bases are formed from the proteids. These bases pharmacologically produce all the signs of the disease, viz.: œdema, heart effects, and para-sympathetic paralysis, and they are not present in the non-inoculated control rice media. Individual susceptibility plays an important part when the amount of poison ingested is small in amount, e.g., the small incidence sometimes seen in a jail population. When the quantity ingested is very large, e.g., in a whole family attacked by epidemic dropsy, it then determines the mortality. Hypo-adrenia in particular, and hypothyroidism to a lesser extent, increase the susceptibility towards these bases, and this in turn is closely correlated with coloration of animals. Rice polishings contain bases that are antagonistic to the bases found in diseased rice. Polished parboil rice is the most dangerous of all rices, and can be protected only by preservatives and proper storage. Adrenalin in small doses, two minims intramuscularly twice a day, diminishes cell permeability and so relieves the œdema, and also antagonizes the action of the water-soluble bases. To a lesser extent it protects the para-sympathetic.

Serum Reactions in Syphilis (R. B. Lloyd).—In this paper no finality has yet been reached; the following is the summary of the present position: While there are material differences amongst some of the leading workers regarding the value of flocculation tests, there is a general consensus of opinion that the Wassermann reaction remains for the present the best test for the detection of syphilis, though one or more of the flocculation tests may be done in addition. The great advantage of the Wassermann test is its high degree of sensitiveness, combined with an almost total absence of false positives. While the earlier flocculation tests have not proved as satisfactory as was expected, the more recent developments are much more promising. Improvements in technique may very possibly enhance the value of Sachs-Georgi test. The Kahn test is simple and apparently very serviceable. The former of these tests, however, is not quantitative. The Dreyer-Ward test is valuable and quantitative, and the technique should admit of simplification. It is probable that some form of flocculation test will eventually attain to extended use; although the difficulty in reading intermediate grades of positive reaction is at present considerable. The occurrence of non-specific reactions in flocculation tests needs further examination. Before any particular flocculation reaction can be accepted as the standard test, it must be clearly shown to be capable of yielding satisfactory results with cerebrospinal fluid; since this is the direction in which syphilis therapy is concentrating.

A Preliminary Note on the Successful Treatment of Kala-azar with "Stibamine Glucoside" (L. E. Napier).—Stibamine glucoside, an aromatic compound allied to sodium-amino-phenyl-stibiate with an antimony content of about 30 per cent. and a minimum lethal dose of about 500 mg. per kilo, has proved successful in the treatment of kala-azar cases at the Carmichael Hospital for Tropical Diseases in Calcutta. The compound, an easily soluble powder, was dissolved in distilled water to make a 4 per cent. solution and was injected intravenously. The initial dose given was 0·1 grm. and 0·2 grm, the maximum dose for patients weighing over 50 lb. The cure was confirmed by direct and

cultural examination of the spleen puncture material, in cases where the spleen was palpable, and of the liver puncture material where it was not, taken about one week after the last injection had been given. It is obvious that this compound is far superior to the antimony tartrates in the treatment of kala-azar.

A Case of Typhoid Septicæmia without Typhoid Ulcers (W. Fletcher and J. E. Lesslar)—Two strains of *B. typhosus*, the one smooth and agglutinable, the other rough and non-agglutinable, were isolated from the blood of an old Chinese labourer, whose serum agglutinated a stock of emulsion of *B. typhosus* in high dilutions. *B. dysenteriæ* Flexner, type X, was isolated from his fæces on each of four occasions when they were examined. The patient died about six weeks after the commencement of his illness. There was no marked thickening or inflammation of the gall-bladder, but an agglutinable strain of *B. typhosus* was cultivated from it There were two old pigmented scars just above the ileocæcal valve, but there were no typhoid ulcers. It is an open question whether the patient was a chronic carrier and the septicæmia the result of infection from an old focus in the gall-bladder, or whether, on the contrary, the gall-bladder had become recently infected as a result of the general septicæmia.

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January 14, 1925.

Coccidium persicum, *nov. sp. Parasite of the Biliary Tract of* Tropidonotus natrix, *var.* persa *Pallas* (Mme. M. Phisalix).—The coccidium described was found in the biliary tract of a number of snakes of Bologna. The complete development of the parasite has been followed by the author, and a full description is given. It belongs to the same genus *Coccidium* (syn.: *Eimeria*) discovered by Debaisieux, but varies in some of its characters, especially the merozoites and microgametes. To distinguish this parasite from the others of the biliary tract the author has named it *Coccidium persicum.*

Chytridial Parasites of the Amœbæ of Man Possibility of their Utilization as Biological Means of Fight against Amœbic Dysentery (A. Lwoff).—This parasite was found in the stools of a patient. It appears to be fairly common in *E. coli* and *E. dysenteriæ*, but up to the present it has not been minutely described. In three amœbæ, out of 400 examined, the parasite was seen in the form of spherical masses made up of a large number of small corpuscles. No nucleus could be detected in their interior. Two of these amœbæ contained only one parasite, the other contained three. The parasite is *Sphærita endogena;* it is minutely described.

The Use of Quinine in the Treatment of Malaria (Ed. and Et. Sergent, L. Parrot, H. Foley and A. Catanei).—This paper is divided into three parts, viz.: The Therapeutic Use of Quinine, The Preventive Use, and The Use of Quinine to Improve the Reservoirs of Virus. Quinine given therapeutically can only be administered according to the condition of the patient and the result of the microscopical examination. As a general rule, the dose for an adult should not exceed 2 gr. pro die. Children generally tolerate proportionally larger doses than adults. Intravenous injections should be given in pernicious attacks of malaria; intramuscular injections in grave cases, in cases of stomachal intolerance and in cases where the doctor wishes to be sure of the absorption of the medicament. Administration *per os* can be given in most cases. In the case of quinine as a preventive of malaria, it cannot be said that quinine absolutely protects one from the malady, but should a person be affected with malaria, in spite of taking quinine, it never takes on the pernicious form. As quinine is rapidly eliminated, daily administration is necessary. Results of the Anti-malarial Service in Algeria prove the efficacy of quinine as a preventive of malaria.

Clinical Observations on Multiple Oriental Sore (M. Neveu-Lemaire).—These observations were carried out in the course of a journey in Syria and Mesopotamia during last autumn, from which the following conclusions may be gathered. All the lesions of this disease appear at the place of an insect bite, very probably the *Phlebotomus*. It is pointed out by the author that in nearly all books on the subject one reads that Oriental sore, in the beginning, resembles an insect bite; he thinks it would be more exact to say that it is on the level of an insect bite that the first lesion appears and this is very probably produced by the inoculation, at the moment of the bite, of the infectious germ. The period of incubation is generally eighteen days. A longer incubation period is exceptional, except in cases of experimental disease. In a patient suffering from Oriental sore there seems to be, during the evolution of the lesion, a marked hypersensibility which has already been described by various authors. The number of cases met with in this series is fifteen. Treatment so far has been unsatisfactory. The application of aseptic dressings has been quite as good as eight injections of emetic, each of 10 cg.

Leprosy in New Caledonia (J. Genevray).—This paper confirms the works on leprosy previously published by several authors during the last ten years or so. The natives of New Caledonia in 1924 numbered 26,857, and of these, 578 were isolated as lepers. The affection is unequally distributed throughout the colony. Cases of nervous leprosy are very common. The diagnosis of suspected cases is not easy; the numerous diseases which are met with such as Raynaud's disease, ainhum, scleroderma, &c., are often cases of error in diagnosis, but 300 to 350 of the suspected cases may be considered as true lepers. This brings the number of lepers up to nearly 900, and to these may be added a percentage of ten, which repre-

sents lepers who get away from observation. Among the Europeans inhabiting New Caledonia 158 cases (0·95 per cent.) of leprosy existed on May 1, 1924, most of which were cases of cutaneous leprosy; nervous cases were rare. There were only eight suspected cases. The men generally are more frequently attacked than the women, both natives and Europeans. The paper is to be continued.

Tests of Treatment of Leprosy at Martinique (R. Baujean).—Twenty cases of leprosy, all of different stages, have been treated with various medicaments, of which chaulmoogra oil, and especially ethyl ethers, have proved to be the most efficacious. Eleven of these cases were ameliorated after treatment, in different degrees, the other nine cases remained stationary during and after treatment.

Piroplasmosis of Bovidæ in the Government of Petrograd in 1923, *Preliminary Note* (W. L Yakimoff, Mlle. W. Z. Wassilewsky and B. Zawialoff).—Bovine piroplasmosis is very common in Petrograd, as it is in all the north-west region of Russia. The ætiological agent of piroplasmosis in Russia is *Babesiella bovis*, and not *Piroplasma bigeminum*, as has been stated by several Russian authors. The latter exists, however, in the south. The two piroplasmoses can be differentiated. The period of incubation is twelve days. The most characteristic feature of this malady is the hæmoglobinuria.

Details of the Transmission of European Recurrent Fever by Lice (C. Chapcheff).—The investigations reported were carried out in North Africa, on *Spirochæta berbera*. During the first series the spirochæte was found in only 13 of the 138 lice collected from cases of recurrent fever during the course of the second to the eighteenth day of the illness. The spirochætes are particularly found in abundance in the hæmolymph of the insects and less often in other parts of the organism. Both male and female lice, of the head and of the body, are equally infected by visible forms of the parasite. None of the lice nourished on patients in the apyrexial stage showed presence of spirilla. These investigations prove that both European and North African recurrent fever are transmitted to healthy subjects by the excrements of lice, and not by the bite of the louse as is commonly believed. Another point of interest is that to contaminate man with exanthematus typhoid one louse bite is sufficient, but to infect recurrent fever a large number of lice is necessary. This difference explains certain epidemiological facts observed in Russia during the epidemic of 1918-20.

Avitaminosis and Infection in Experimental Disease of the Young Pig due to Bacillus asthenogenes. *Investigations on Beriberi* (P. Noel Bernard).—The conclusions which may be gathered from these investigations are that rice-bran, in which vitamin B has been destroyed by heating at 135° for one hour does not cause the beriberi syndrome in young pigs in 110 days. The syndrome is seen in less than 110 days, by infection due to *B. asthenogenes*, in young pigs which have absorbed cultures of the infectious germ and fed with polished rice or rice-bran, heated at 100° for twenty minutes, which is generally considered insufficient to destroy vitamin B. Polished rice is one of the essential causes of the production of the experimental disease. The bran exercises a protective action against the infection by its nutritive value and other qualities. The experimental disease of the young pig is a toxi-infection, the beginning of which is the alterations in the gastro-intestinal functions under the influence of an alimentation which favours the infectious germ, its multiplication, and the production of its toxin, and in which the evolution, which begins with the beriberi syndrome, depends on the absorption of this toxin by the organism.

Apropos Ganglionic Substance Particularly Rich in Trypanosoma gambiense (R. Guillet).—From this article there is reason to believe that sleeping sickness constitutes a great danger in certain regions of Senegal. A native, forty-five years of age, was sent to the Pasteur Institute for microscopical control of the diagnosis of trypanosomiasis. He complained of having become thin and of fatigue. A very clear cervical polyadenitis was present, and a characteristic, large, soft ganglion on the right was observed. Puncture of the ganglion showed a true culture of trypanosomes; in one field fourteen flagellates were counted. This case is interesting inasmuch as it is apparently the first during the three years' investigation of the author, in which the ganglionic substance has been so rich in trypanosomes.

Medical News.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE.

Examination Results.

Division of Tropical Medicine and Hygiene.

The following Medical Officers passed the School Examination at the termination of the 77th Session (January-March, 1925):

Passed with Distinction.— Craighead, A. C. (winner of "Duncan" Medal); Haworth, A. N.; Klaber, R.; Goldsworthy, N. E.; Mohammed, A. S.

Passed.—Lumsden, K.; Vickers, W. J.; Garnham, P. C. C.; Campbell, A. H.; Cook, E. N.; Banks, J. N.; Graham, J. W.; Monks, A. B.; Fraser, E. M.; Struthers, E. B.; Grant, P. F. A.; Brown, H. H.; Bowyer, J. H.; Ali, M.; Gordon, J.; Manley, J.; Speirs, R. C.; Goodwin, T. S.; Read, F. C.; Lal, M.; More, H. J.; Enzer, J.; Wilde, O. G.; Thambiah, R. W. C.; Coomarasamy, A. N.; Moffatt, G. M.; Maclean, A. H.; Stuart, J. L.; Mumford, R. H.; Pan, T. C.; Chan, V. F. T.

March 31, 1925.

New Preparations, Inventions, &c.

A NIGHT TRAP FOR GNATS, MOSQUITOES, AND TSETSE FLY.[1]

Dr. F. W. ALEXANDER, Medical Officer of Health for Poplar, has designed a simple device to trap insects which fly by night. In the centre of a wooden base a well-protected night-light or electric bulb is fixed. This is surrounded by vertical sheets of ground glass arranged in wooden sockets, so as to be placed in any desired position. The glass sheets are smeared with honey or some other sticky substance, which can easily be washed off and replaced. The whole apparatus can be fixed on a pole and placed where the insects are most likely to be found. Dr. Alexander points out that this device can be made for a few shillings, apart from any storage battery or accumulator if an electric lamp is used.

"SOLOID" URINE-SUGAR TEST CASE.

THIS case combines simplicity with utility and has been specially designed by Messrs. Burroughs Wellcome & Co. for those diabetics who are under insulin treatment at home. The case is made of stout cardboard and contains a liberal supply of tests, twenty-four in all.

The full contents are two tubes of "Soloid" Alkaline Citrate, one tube of "Soloid" Copper Sulphate, one medicine dropper with rubber bulb, two test-tubes graduated, one wire test-tube holder, one small square of asbestos, and one bottle of twenty-five "Soloid" Hexamethylenetetramine (one of these placed on the asbestos square will burn for three minutes, sufficiently long to conduct one test.)

The test is very reliable, and amounts as low as 0·1 per cent. of glucose are read with ease. The introduction of a simple heating medium, obviating the employment of methylated spirit, is a feature which will be readily appreciated. The flame is smokeless and therefore there is no tendency for the reading to become obscured.

The case is very compact, measuring 5 in. by 4¼ in. by 1⅛ in. and may easily be carried in the pocket.

BOVRIL LIMITED.

ANOTHER RECORD YEAR.

PRESIDING at the twenty-eighth annual general meeting of Bovril Limited, held in London on March 4, Sir George Lawson Johnston (Chairman) congratulated the shareholders on having had a successful year. He said:—

"The gross profit on trading, less advertisements, stands at £639,123, as against £571,491 for the year 1923. This gross profit, of course, constitutes a record, whilst the expenditure on advertising, which has already been deducted from the gross profit, also reached record figures. The debtor side of this account shows us the nett profit of £390,992, as against £351,898 in the previous year. As indicated in the report, this increase is the result of a very gratifying expansion in the home and export sales of Bovril during the year 1924."

The Selling Value of a Smile.

Referring to recent advertising schemes, Sir George Lawson Johnston emphasized how the display of some of the series of Bovril posters brought back advertising memories of the last quarter of a century, and many were surprised to see how long a slight tinge of humour had been a feature of these posters, which otherwise depict a serious food fact.

It is rather surprising that it is only in recent years that a touch of humour in posters has become prevalent.

Sir James Crichton-Browne on Food and Physical Efficiency.

Sir James Crichton-Browne said the Company was constantly receiving testimony to the sterling value of Bovril from all quarters of the globe and under the most diverse conditions. Bovril had been used largely by the enterprising Oxford University Arctic Expedition, by which, for the first time in history, an aeroplane had been employed in arctic exploration; it had been carried by Mr. Simpson, of the *Daily Telegraph* Expedition, which twice crossed the Continent of Australia in a Bean motor-car; and supplies of Bovril had been laid down at ten selected depot points for the use of the great Cape to Cairo motor expedition, now in progress under the leadership of Captain Court Treatt. These were emergency uses of Bovril. The extent of its routine and habitual consumption was best shown by the figures which had been submitted to the shareholders. Bovril was of firmly established reputation and world-wide acceptance, and he ventured to predict for it a still growing popularity. It represented in an agreeable and easily assimilable form that animal protein upon which all the great nations of the world had been built up, and the amount of which, as a food constituent—as Lieut.-Colonel McCarrison, a very high authority, had just shown—might be taken as a measure of the physical efficiency and power of resistance to disease of the different races of India.

On the nutrient properties of Bovril, Sir James said he need not enlarge, but he would claim for it what might be called a vitaminic virtue also. The vitamins, which were now becoming household words, were not in themselves foods, and did not nourish, but were essential to nutrition, and gave a fillip to certain metabolic changes in the system. Bovril did that also, as Prof. Thompson's experiments had conclusively proved, and at the same time it did what the infinitesimal vitamins could not do—it renewed the tissues and yielded energy. Bovril was a food in itself, and promoted the assimilation of other foods.

[1] Reprinted from the *British Medical Journal*, February 7, 1925.

Original Communications.

A STUDY OF INTENSIVE ANTIMONY-THERAPY IN SCHISTOSOMIASIS JAPONICA.[1]

By Henry Edmund Meleney, M.D., Ernest Carroll Faust, Ph.D., and Corydon McA. Wassell, M.D.

Introduction.

In spite of the extensive use of tartar emetic in the treatment of vesical and rectal bilharziosis since the first successful trial by Christopherson in 1917 (1918), it has been felt by careful practitioners coming in contact with cases of Oriental schistosomiasis that the drug is still on trial with respect to treatment of this latter infection. In Egyptian bilharziosis thousands of cases are treated annually with intravenous injections of tartar emetic, the greater majority in out-patient clinics, and the symptoms of toxæmia following the administration of the drug are so negligible as to have little effect on the willingness of the patient to submit to a full course of treatment. While Sanders and Priston (1921), Tyau (1922), Tootell (1923), and Faust and Meleney (1924) have reported favourably on the effect of this drug in incipient or moderately advanced cases of schistosomiasis japonica, it has been administered only on in-patients, the majority of whom were persuaded only with difficulty to complete a full course of treatment. Furthermore, Libby (1923, 1924) has called attention to the apparently marked toxic symptoms attendant on the administration of small quantities of the drug to advanced cases with ascites.

It was with these facts in mind and with the idea of giving tartar emetic a careful test in several closely observed cases before advocating its use unreservedly for all persons found to harbour *Schistosoma japonicum* that this study was undertaken. Since incipient cases as such seldom appear in the clinics in the endemic areas in China, it was believed that moderately advanced cases, either quiescent or mildly active, should be selected for the study. They were to be carefully observed and examined from all aspects of the disease, but were to be especially tested with respect to (1) their reaction to intravenous injections of tartar emetic administered in moderately heavy doses; and (2) the potency of the drug in killing the parasite.

It was found advisable to select Wuchang, in the centre of the endemic area of the mid-Yangtze region, where, in the clinics of the Church General Hospital, suitable patients could be found for the investigation. The method of procedure was based on past experience with reference to the difficulty in securing patients to take a full course of treatment with antimony.

[1] Contribution from the Department of Medicine and from the Parasitology Laboratory, Pekin Union Medical College.

Outline of Procedure for Intensive Treatment of Schistosomiasis Japonica.

(1) A series of cases was to be studied, being kept in the hospital under direct observation for a period of about six months.

(2) The cases selected were to be favourable for treatment, the infection in each one being moderately severe, but not advanced to the stage of marked ascites. Males between the ages of fifteen and thirty years were to be chosen if possible.

(3) The patients were to be employed by the hospital as coolies with slight compensation in order to keep them under observation.

(4) The patients were to agree to stay in the hospital for six months, not returning to their homes during that time. This precaution was to be taken in order to avoid the possibility of re-infection.

(5) Patients were to be provided a hospital bed or its equivalent in a "convalescent hostel" for the whole period of six months. While acutely ill or while under intensive treatment patients were to be kept in bed. At other times they might be given light work to do about the hospital.

(6) Careful clinical and laboratory records were to be kept of each patient. These included:

(*a*) On admission: (1) Detailed history and physical examination. (2) Complete blood count—red blood cells, hæmoglobin, white blood cells, differential; search for blood parasites. (3) Globulin precipitation test. (4) Total serum proteins. (5) Wassermann. (6) Routine urinalysis. (7) Stool examination, gross and microscopic.

(*b*) During treatment, daily: (1) Urine for albumin. (2) Stool for schistosome eggs, washed and hatched for viability of eggs.

(*c*) During treatment, weekly (or as frequently as advisable): (1) Globulin precipitation test. (2) Differential blood count. (3) Measurement of size of liver and spleen.

(*d*) After treatment, weekly: (1) Stool for schistosome eggs, washed and hatched for viability of eggs.

(*e*) After treatment, monthly (or as occasion permitted): (1) Complete blood count. (2) Globulin precipitation test. (3) Total serum proteins. (4) Measurement of size of liver and spleen.

(7) *Treatment.*—With chemically pure potassium antimony tartrate intensively, similar to treatment of American naval officer at Peking Union Medical College in 1923 (Faust and Meleney, 1924).

Treatment in each case should cover not over one month. Thereafter further treatment was to be given only if evidence appeared that patient was not cured (i.e., that the worms were not yet dead). This was to be determined by: (*a*) Reappearance of viable eggs in fæces. (*b*) Reappearance of positive globulin test.

It will be seen from the protocols and data which follow that this ideally thorough intensive course of treatment was not entirely feasible. However, we believe that the data in hand have a direct bearing on the inquiry initiated and should be placed in written form.

TABLE I.—REACTION OF SCHISTOSOMIASIS

Day	Case 1					Case 2					Case 3				
	Dosage T.E.	Total to date	Reaction			Dosage T.E.	Total to date	Reaction			Dosage T.E.	Total to date	Reaction		
			Cough	Nausea	Vomiting			Cough	Nausea	Vomiting			Cough	Nausea	Vomiting
	grm.	grm.				grm.	grm.				grm.	grm.			
1	·050	·050	0	0	0	·050	...	0	+	0	·050	...	0	0	0
2	·075	·125	0	0	0	...	...	...	...	...	...	...	...	...	...
3	·100	·225	0	+	0	·075	·125	0	0	0	·075	·125	0	0	0
4	...	...	...	...	...	·075	·200	0	0	0	...	...	...	...	...
5	·100	·325	0	+	0	...	...	...	...	...	·100	·225	0	0	0
6	...	...	...	...	...	...	...	...	...	...	·125	·350	0	0	0
7	·100	·425	0	+	0	...	...	...	...	...	·125	·475	0	0	0
8	·100	·525	0	+	0	·100	·300	0	+	0	...	...	...	...	...
9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10	·100	·625	0	0	0	·100	·400	0	+	0	·100	·575	0	0	0
11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13	·075	·700	0	0	0	·075	·475	0	+	0	...	...	...	...	...
14	...	...	...	...	...	·075	·550	0	+	0	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...	·080	·655	0	0	0
16	...	...	...	...	...	·075	·625	0	0	0	...	...	...	...	...
17	·075	·775	0	0	0	...	...	...	...	...	...	...	...	...	...
18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19	·075	·850	0	0	0	...	...	...	...	...	·100	·755	0	0	0
20	·075	·925	0	0	0	·075	·700	0	0	0	...	...	...	...	...
21	...	...	...	...	...	...	...	...	...	...	·100	·855	0	0	0
22	·075	1·000	0	0	0	...	...	...	...	...	...	...	...	...	...
23	·075	1·075	0	0	0	·075	·775	0	+	0	...	...	...	...	...
24	·075	1·150	0	0	0	...	...	...	...	...	...	...	...	...	...
25	...	...	...	...	...	·100	·875	0	+	0	...	...	...	...	...
26	...	...	...	...	...	...	...	...	...	...	·120	·975	0	0	0
27	·075	1·225	0	0	0	·100	·975	0	0	0	·120	1·095	0	0	0
28	·075	1·300	0	0	0	...	...	...	...	...	...	...	...	...	...
29	·075	1·375	+	+	0	·075	1·050	+	+	0	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
31	·075	1·450	+	+	0	·075	1·125	0	+	0	...	...	...	...	...
32	·100	1·550	+	+	0	...	...	...	...	...	...	...	...	...	...
33	·100	1·650	+	+	0	...	...	...	...	...	...	...	...	...	...
34	...	...	...	...	...	·075	1·200	0	0	0	·150	1·245	0	0	0
35	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36	...	...	...	...	...	·075	1·275	0	0	0	·176	1·421	0	+	+
37	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
38	...	...	...	...	...	...	...	...	...	...	·150	1·571	0	+	0
39	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
41	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
42	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43	...	...	...	...	...	·075	1·350	0	0	0	...	...	...	...	...
44	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
45	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
46	...	...	...	...	...	·075	1·425	0	0	0	...	...	...	...	...
47	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
48	...	...	...	...	...	·075	1·500	0	+	0	...	...	...	...	...
49	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50	...	...	...	...	...	·075	1·575	0	+	+	...	...	...	...	...
51	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
52	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
53	...	...	...	...	...	·075	1·650	0	+	0	...	...	...	...	...
54	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
55	...	...	...	...	...	·075	1·725	0	+	0	...	...	...	...	...
56	...	...	...	...	...	·100	1·825	0	+	+	...	...	...	...	...
57	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
58	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
59	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
60	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
61	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
62	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

PATIENTS TO TARTAR EMETIC.

CASE 4					CASE 5					CASE 6					CASE 7				
Dosage T.E.	Total to date	Reaction			Dosage T.E.	Total to date	Reaction			Dosage T.E.	Total to date	Reaction			Dosage T.E.	Total to date	Reaction		
		Cough	Nausea	Vomiting			Cough	Nausea	Vomiting			Cough	Nausea	Vomiting			Cough	Nausea	Vomiting
grm.	grm.				grm.	grm.				grm.	grm.				grm.	grm.			
·050	...	0	0	0	·050	...	0	0	0	·050	...	0	0	0	·050	...	0	0	0
...	...	...	...	...	·075	·125	0	0	0	...	...	...	...	...	·075	·125	0	0	0
·075	·125	0	0	0	·100	·225	0	0	0	·075	·125	0	0	0	·100	·225	0	+	0
·100	·235	0	+	+	...	...	...	...	...	·100	·225	0	0	0	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	·100	·325	0	0	0	·100	·325	+	+	0
...	...	...	...	...	·100	·325	0	0	0	...	...	...	...	...	·100	·425	0	0	0
·100	·335	0	+	0	...	...	...	...	...	·100	·425	0	0	0	...	...	...	...	...
·100	·435	0	+	0	...	...	...	...	...	...	...	...	...	...	·100	·525	+	0	0
·100	·535	0	+	0	...	...	...	...	...	...	...	...	...	...	·100	·625	0	0	0
...	...	..	...	...	·100	·425	0	0	0	·100	·525	+	+	0	...	...	...	...	...
...	...	...	...	...	·100	·525	0	0	0	·100	·625	0	0	0	·100	·725	+	0	0
·075	·610	0	+	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
·075	·685	0	+	0	·100	·625	0	+	0	·100	·725	0	0	0	...	...	...	...	...
·075	·760	0	0	0	·125	750	0	+	0	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
·100	·860	0	0	0	·125	·875	0	+	0	...	..	...	...	...	·100	·825	+	+	0
·100	·960	0	0	0	...	...	...	...	...	·075	·800	0	0	0	·100	·925	0	+	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
·100	1·060	0	0	0	...	...	...	...	...	·100	·900	+	0	0	...	...	...	...	...
·100	1·160	0	0	0	·075	·950	0	+	0	...	...	...	...	...	·100	1·025	+	0	0
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·100	1·260	0	0	0	·075	1·025	0	+	0	...	...	..	...	...	...	...	...	...	...
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...	...	..	...	...	·100	1·125	0	0	0	...	...	...	...	...	...	...	...	...	...
·100	1·360	0	0	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
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·100	1·460	0	0	0	...	...	...	...	...	...	...	...	...	...	...	...	...	.	...
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·100	1·560	0	0	0	·080	1·305	0	0	0	·050	1·150	0	0	0	...	...	...	...	...
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·100	1·660	0	0	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
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·100	1·760	0	+	0	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
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·100	1·860	0	0	0	...	...	...	...	...	·075	1·225	0	+	0	...	...	...	...	...
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·100	1·950	0	0	0	·075	1·455	0	0	0	...	...	...	...	...	...	...	...	...	..
·100	2·060	0	0	0	...	...	...	...	...	·075	1·300	0	+	0	...	...	...	...	...
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...	...	...	...	...	·075	1·830	0	+	0	·075	1·675	0	0	0	·100	1·730	+	+	+
...	...	...	...	...	·100	1·930	0	+	0	...	...	...	...	...	...	...	...	...	...
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[1] Urine examination throughout the treatment was consistently negative for albumin

Protocol of Cases.[1]

Altogether ten cases were examined[2] for this study, of which seven are reported in this paper.

Case 1.—L. K. S., age 25, farmer from Hupeh Province, was admitted to the Men's Department of the Church General Hospital on March 4, 1924, complaining of respiratory trouble and skin infection on the scalp. On examination he was found to be in a fair state of nutrition, but under-developed. Weight, 86¼ lb.; height, 4ft. 10½in.; muscles undeveloped, slight atrophy and extreme weakness in legs and arms. Examination of the head showed a dry scaly skin with favus on the scalp. Coarse moist râles at right hilus of lungs both front and back. The heart gave a rough systolic murmur in pulmonic area. Abdomen had the shape of an inverted gourd, irregularly barrel-shaped; circumference at costal margin 75 cm., at umbilicus 67·5 cm. Small amount of free fluid in abdomen. Liver hard, 7 cm. below xiphoid cartilage, 4·5 cm. below costal margin in right mid-clavicular line. Spleen edge 7 cm. at greatest distance perpendicular to left costal margin. Descending colon appreciably thickened.

Laboratory Findings.—R.B.C., 2,790,000; hgb., 37; W.B.C., 5,500; neutrophiles, 72 per cent.; basophiles, 1·5 per cent.; eosinophiles, 14 per cent.; lymphocytes, 9 per cent.; large mononuclears, 1·5 per cent.; transitionals, 2 per cent. Urine, negative. Fæces, eggs of *Schistosoma japonicum*, hookworm. Serum globulin, + +; Wassermann negative. Total serum proteins, 9·06 per cent.; albumin, 3·29 per cent.; serum globulin, 5·77 per cent.

Diagnosis.—Schistosomiasis japonica; bronchitis.

Therapy.—Potassium antimony tartrate treatment was begun on March 7 with an initial dose of 5 c.c. (one per cent. sol.). First reaction on the third day, when a total dosage of 0·225 grm. had been given. Following this initial reaction, the time interval for administering the drug was governed in part by the condition of the patient. However, no marked reaction was observed until the twenty-ninth day of treatment, when 1·375 grm. of the drug had been given. From this time on, both nausea and coughing were common reactions to the drug. On the thirty-third day, when 1·650 grm. had been administered, it seemed advisable to discontinue treatment for a time. On the fortieth day, just as treatment was to be reinstituted, the patient ran away. The study was, therefore, incomplete, although daily laboratory records (see Table II) showed that eggs appeared for the last time in the fæces on the ninth day and miracidia were hatched from total fæcal samples for the last time on the twenty-sixth day. Likewise the temperature chart, which was extremely variable preceding and during treatment, appreciably improved during the last week of observation. It seems likely that a sufficient amount of the drug had been administered to

[1] Reaction of patients to tartar emetic is indicated in Table I.

[2] Three of these cases left the hospital before treatment was initiated.

Table II.

No.	Primary diagnosis	Complications	Physical findings	Laboratory findings							Treatment—pot.-antim.-tart.				Effect
				Eosinophils per cent.	Hb. (Sahli)	Serum globulin precipitation		Protein			Wassermann	Amount	Period	Positive for	
								Total per cent	Albumin per cent	Serum globulin per cent				Eggs	Hatched Miracidium	
												grm.	days	days	days	
1	Schistosomiasis japonica	Ankylostomiasis; bronchitis	Retarded growth, pallor and emaciation, bronchitis, enlarged liver and spleen, ascites; descending colon thick	14	37	++	(1)	9·06	3·29	5·77	–	1·65	33	9	26	Incomplete (ran away)
2	Schistosomiasis japonica	None	Retarded growth, enlarged liver and spleen	10	48	+++	(1)	9·13	3·97	5·16	–	1·825	63	13	37	Cured (?)
							(2)	8·80	4·67	4·13						
3	Schistosomiasis japonica	Syphilis	Undeveloped genitalia; enlarged liver and spleen	23	44	++	(1)	8·67	4·27	4·40	++	1·57*	38	14	30	Cured (?)
							(2)	9·16	4·63	4·53						
4	Schistosomiasis japonica	None	Enlarged liver	31	66	–	(1)	9·66	5·88	3·78	–	2·376	52	29	41	Cured (?)
							(2)	9·15	5·82	3·33						
5	Schistosomiasis japonica	Scabies	Retarded development, enlarged liver and spleen	15	48	++	(1)	9·72	3·17	6·55	–	2·030	56	26	31	Cured (?)
							(2)	8·55	4·23	4·32						
6	Schistosomiasis japonica	None	Retarded development, enlarged liver and spleen	10	40	++	(1)	8·76	4·31	4·45	–	2·050	62	33	45	Cured (?)
							(2)	8·20	3·96	4·24						
7	Schistosomiasis japonica	Ankylostomiasis	Retarded development, enlarged liver and spleen	18	43	+	(1)	8·92	4·20	4·72	Anti-comp.	2·005	60	28	39	Cured (?)
							(2)	8·38	4·50	3·88						

effect a cure, although time would be required to repair the damage to the liver and intestinal tract brought about by the infection.

Case 2 (fig. 1).—C.S.N., age 21, farmer from Hupeh Province, was admitted to the Church General Hospital on March 28, 1924, complaining of abdominal discomfort and slight fever and chills. On examination he was found to be under-developed but with a fair degree of nutrition. Weight, 60 lb.;

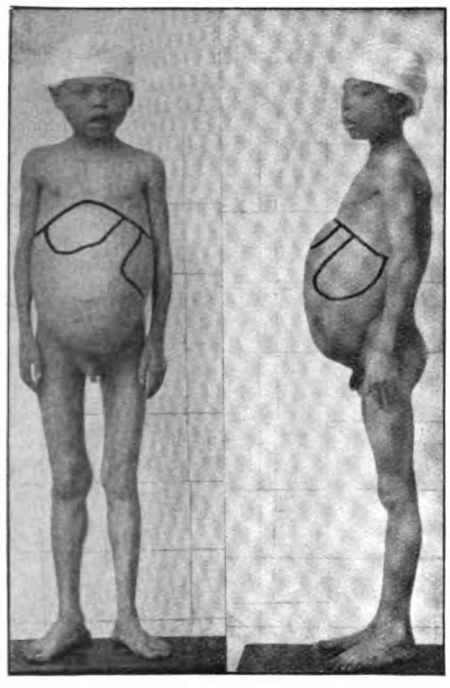


Fig. 1.—Patient of Case 2, front and left profile view, showing outline of liver and spleen.

height, 4ft. 3½in.; body fairly strong. Lungs normal; heart normal. Abdomen barrel shape; circumference at costal margin 70 cm., and at umbilicus 69 cm. No free fluid. Liver hard, nodular, 6 cm. below the xiphoid cartilage and 6 cm. below costal margin in right mid-clavicular line. Spleen edge 22·5 cm. at greatest distance perpendicular to left costal margin. Colon appreciably thickened; abdominal veins visible. Anæmia.

Laboratory Findings.—R.B.C., 2,800,000; hgb., 48; W.B.C., 1,200 (?); neutrophiles, 77 per cent.; basophiles, 2 per cent.; eosinophiles, 10 per cent.; lymphocytes, 6 per cent.; large mononuclears, 3 per cent. Urine negative. Fæces, eggs of *Schistosoma japonicum*, hookworm, *Ascaris*, *Trichuris*. Serum globulin, + + +; Wassermann negative. Total serum proteins, 9·13 per cent.; albumin, 3·97; serum globulin, 5·16 per cent.

Diagnosis.—Schistosomiasis japonica.

Therapy.—Potassium antimony tartrate treatment was begun on April 3 with an initial dose of 5 c.c. (one per cent. sol.). Slight nausea after administration of first dose; further reaction after 0·3 grm. of the drug had been administered. Cough not marked until twenty-ninth day, when 1·05 grm. had been given. Treatment continued at intervals until fifty-sixth day, when it was deemed advisable to discontinue administration due to marked reaction. Total drug given, 1·825 grm. Eggs last found on the thirteenth day and miracidia on the thirty-seventh day after treatment was instituted.

Examination at end of period of treatment as follows: R.B.C., 2,246,000; W.B.C., 1,600 (?). Eosinophiles, 6 per cent. Total serum proteins, 8·80 per cent.; albumin, 4·67 per cent.; serum globulin, 4·13 per cent. Weight, 68 lb. Liver, 9 cm. below xiphoid cartilage, not palpable at right mid-costal margin. Spleen edge 9 cm. at greatest distance perpendicular to left costal margin. General improvement marked. Sixty days after treatment was begun the patient was dismissed as probably cured.

Case 3 (fig. 2).—M.P.I., age 18, a farmer from Hupeh Province, was admitted to hospital on April 10, 1924, complaining of abdominal discomfort. On examination he was found to be under-developed, but in a fair state of nutrition. Weight, 78 lb.;

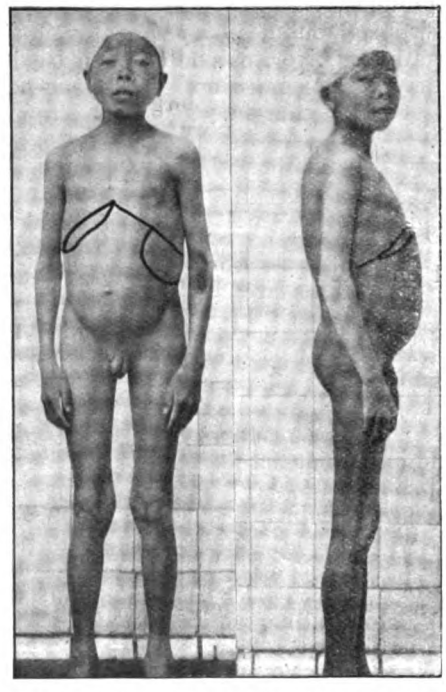


Fig. 2.—Patient of Case 3, front and right profile view, showing outline of liver and spleen.

height, 4ft. 11¾in. Muscles weak. Lungs and heart normal. Abdominal girth at costal margin 74 cm.; at umbilicus, 72 cm. No free fluid. Liver soft, extending 4 cm. beyond the right costal margin, but not palpable at midline. Spleen extending as a discoidal mass 9 cm. perpendicular to left costal margin.

Laboratory Findings.—R.B.C., 3,328,000; hgb., 44 per cent.; W.B.C., 9,200; neutrophiles, 30 per cent.; basophiles, 0; eosinophiles, 23 per cent.;

lymphocytes, 31 per cent.; large mononuclears, 13 per cent.; transitionals, 3 per cent. Urine, negative. Fæces, eggs of *Schistosoma japonicum*, hookworm, *Ascaris*. Serum globulin + + ; Wassermann + +. Total serum proteins, 8·67 per cent.; albumin, 4·27 per cent.; serum globulin, 4·40 per cent.

Diagnosis.—Schistosomiasis japonica and syphilis.

Therapy.—Potassium antimony tartrate treatment was begun on April 12 with an initial dose of 5 c.c. (1 per cent. sol.), and was continued at intervals until the thirty-sixth day of treatment, when the first marked toxic symptoms were observed. Two days later, when 1·571 grm. of the drug had been administered, treatment was terminated.

The last eggs were found in fæces on the fourteenth day and the last miracidia were hatched thirty days after treatment was begun. It must be noted that a year previously 0·67 grm. of tartar emetic had been administered to the patient, so that the total amount which he had received within the year was 2·24 grm.

Examination at end of period of treatment showed the following: Weight, 86 lb.; R.B.C., 3,392,000; W.B.C., 4,200; eosinophiles, 6 per cent. Total serum proteins, 9·16 per cent.; albumin, 4·63 per cent.; serum globulin, 4·53 per cent.; precipitation test negative. Liver, extending 5 cm. below right costal margin; spleen, 8 cm. in line perpendicular to left costal margin. General improvement marked.

Seventy days after admission the patient was dismissed as probably cured.

Case 4 (fig. 3).—M.I.L., age 15, herder and farmer from Rupeh Province, was admitted to the hospital on March 21, 1924, complaining of heatstroke. On examination he was found to be well developed physically. Height, 4ft. 10in.; weight, 72½ lb. Lungs and heart normal. Abdomen 68 cm. in circumference at costal margin; somewhat enlarged between umbilicus and symphysis pubis. Liver 4 cm. below xiphoid cartilage; 5 cm. below right mid-clavicular line; soft in consistency. Spleen not palpable.

Laboratory Findings.—R.B.C., 4,040,000; hgb., 66; W.B.C., 9,000; neutrophiles, 62 per cent.; basophiles, 0 per cent.; eosinophiles, 31 per cent.; lymphocytes, 5 per cent.; large mononuclears, 2 per cent. Urine negative. Fæces, eggs of *Schistosoma japonicum*. Serum globulin, negative; Wassermann negative. Total serum proteins, 9·66 per cent.; albumin, 5·88 per cent.; serum globulin, 3·78 per cent.

Diagnosis.—Schistosomiasis japonica (secondary stage).

Therapy.—Potassium antimony tartrate treatment was begun on March 27 with an initial dose of 5 c.c. (1 per cent. sol.), and was continued forty-nine days, during which time 2·15 grm. of the drug were administered. The reaction to the drug was very slight, being noted most conspicuously on the fourth day of treatment, when a total dosage of 0·235 grm. had been given. The total amount was finally increased to 2·376 grm.

The last eggs were found in the fæces on the twenty-ninth day and the last miracidia were hatched on the forty-first day after treatment was begun.

Examinations made from time to time until June 18, when the patient was dismissed, showed urine negative for albumin, and the fæces negative for hatched miracidia during the last five weeks of observation. On June 9 a second examination showed: total serum proteins, 9·15 per cent.; albumin, 5·82 per cent.; serum globulin, 3·33 per cent. The liver was in practically the same position as on initial examination, and the spleen was just palpable on inspiration. Weight, 77 lb. General condition excellent. Ninety days after admission the patient

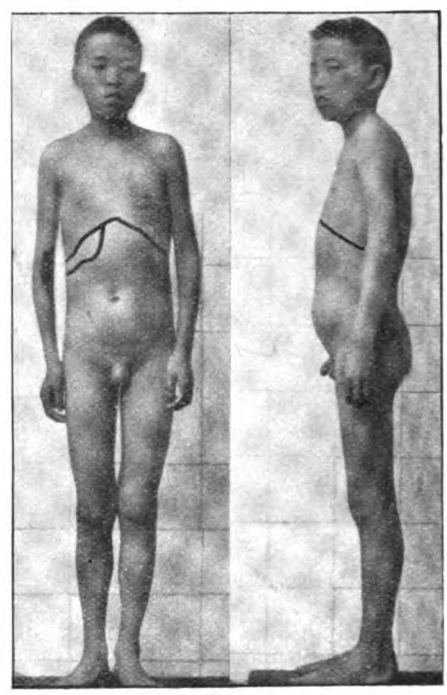


Fig. 3.—Patient of Case 4, front and left profile view, showing outline of liver and spleen.

was dismissed with the belief that he was cured. Two months later he returned for examination, which showed an increase in weight, diminution of the liver, and general improvement.

Case 5 (fig. 4).—M.C.P., age 22, farmer from Hupeh Province, was admitted to the hospital on March 28, 1924, complaining of general abdominal distress. On examination he was found to be under-developed, with poor nutrition and moderate pallor. Height, 4ft. 6½in.; weight, 65 lb. Lungs and heart normal. Abdominal girth 72 cm. at costal margin and 74 cm. at umbilicus. Free fluid in abdomen. Liver 10 cm. below xiphoid cartilage, 3 cm. below costal margin in left mid-clavicular line and 4 cm. below costal margin in right mid-clavicular line; hard, nodular. Spleen 11 cm., perpendicular to left costal margin. Colon and omentum thickened.

Laboratory Findings.—R.B.C., 3,664,000; hgb., 48 per cent.; W.B.C., 6,400; neutrophiles, 58 per cent.; basophiles, 0 per cent.; eosinophiles, 15 per cent.; lymphocytes, 27 per cent. Urine negative. Fæces positive for eggs of *Schistosoma japonicum*, hookworm and *Trichuris*. Serum globulin, + +; Wassermann negative. Total serum proteins, 9·72 per cent.; albumin, 3·17 per cent.; serum globulin, 6·55 per cent.

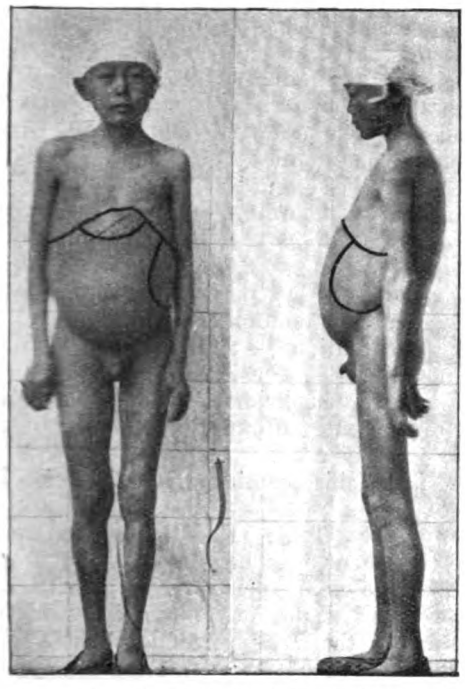


FIG. 4.—Patient of Case 5, *ibid.*

Diagnosis.—Schistosomiasis japonica.

Therapy.—Potassium antimony tartrate treatment was begun on April 2 with an initial dose of 5 c.c. (1 per cent. sol.) and was continued over a period of 56 days, during which time 2·03 grm. of the drug were administered. No reaction was observed until the thirteenth day of treatment (0·625 grm.), but was not marked until 1·555 grm. had been administered. From this time on until the full dosage had been given it was constantly present. The last eggs were found on the twenty-sixth day and the last miracidia hatched on the thirty-first day after treatment was begun. Treatment was therefore continued for twenty-five days following the last positive laboratory diagnosis.

On examination on June 1 the liver had receded two centimetres in the mid-frontal line, while the spleen had receded three centimetres toward the left costal margin. The weight had increased to 70 lb. The total serum proteins amounted to 8·55 per cent.; albumin, 4·23 per cent.; serum globulin, 4·32 per cent. R.B.C., 3,128,000; W.B.C., 3,400; neutrophiles, 56 per cent.; basophiles, 2 per cent.; eosinophiles, 14 per cent.; lymphocytes, 13 per cent.; large mononuclears, 1 per cent. On August 5, when the patient returned for re-examination, the spleen had further receded, so that it was palpable only 5 cm. beyond the costal margin. Weight, 76 lb.; R.B.C., 3,760,000; hgb., 52 per cent.; W.B.C., 5,420; neutrophiles, 37 per cent.; eosinophiles, 15 per cent.; small mononuclears, 18 per cent.; large mononuclears, 20 per cent. The patient showed a marked improvement and gave all indications of being cured.

CASE 6 (fig. 5).—L.T.Y., age 18, farmer boy from Hupeh Province, was admitted to the hospital on March 28, 1924, complaining of slight pulmonary discomfort and abdominal fullness. On examination he was found to be in a fair stage of nourishment but under-developed. Height, 4ft. 1½in.; weight, 59 lb. Left lung slightly duller than right; moist râles at right bases. Heart normal. Abdomen barrel-shaped ("pot-belly"), with a girth of 74 cm. at costal margin and 72·3 cm. at umbilicus. Free fluid and shifting dullness. Liver palpable 6·8 cm. below xiphoid cartilage, 6·5 cm. below costal margin in left mid-clavicular line, and 5·5 cm. below costal margin in right mid-clavicular line. Consistency hard, nodular. Spleen extending 15·5 cm. at great distance perpendicular to left costal margin. Colon and omentum thickened. Abdominal veins visible.

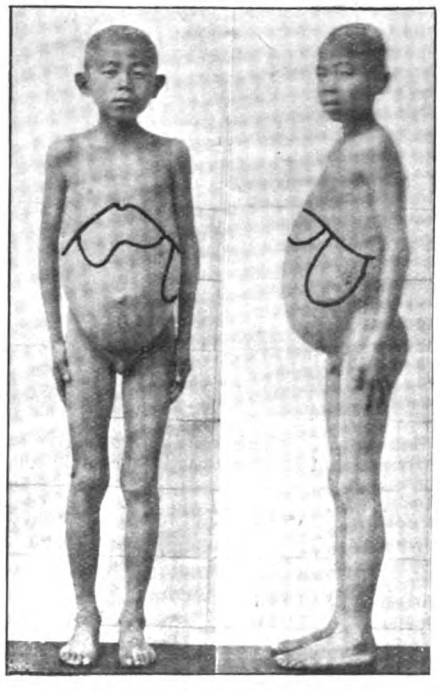


FIG. 5.—Patient of Case 6, *ibid.*

Laboratory Findings.—R.B.C., 4,120,000; hgb., 40 per cent.; W.B.C., 4,000; neutrophiles, 64 per cent.; basophiles, 1 per cent.; eosinophiles, 10 per cent.; lymphocytes, 13 per cent.; large mononuclears, 12 per cent. Urine negative. Fæces, eggs of *Schistosoma japonicum* and hookworm. Serum globulin precipitation + +; Wassermann negative.

Total serum proteins, 8·76 per cent.; albumin, 4·31 per cent.; serum globulin, 4·45 per cent.

Diagnosis.—Schistosomiasis japonica.

Therapy.—Potassium antimony tartrate treatment was begun on April 5 with an initial dose of 5 c.c. (1 per cent. sol.), and continued for a period of 62 days, during which time 2·05 grm. of the drug were administered. The first reaction was observed on the tenth day, when 0·525 grm. of the drug had been administered. After 1 grm. of the drug had been given it became necessary to increase the interval between injections due to the low tolerance of the patient. The patient was kept under direct observation for two weeks following completion of the treatment and then dismissed as materially improved and probably cured. The eggs were found for the last time in fæcal smears on the thirty-third

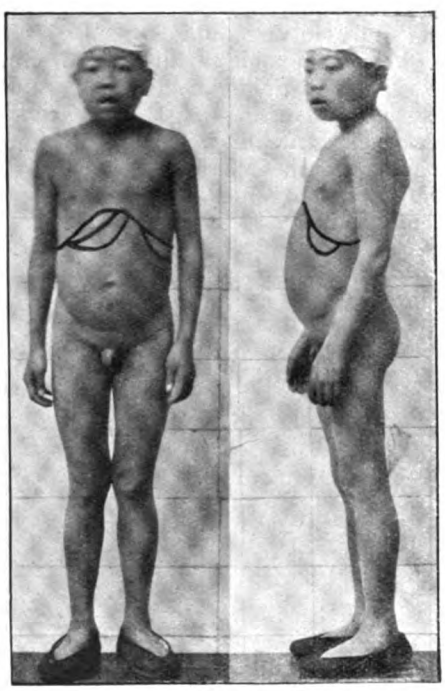


FIG. 6.—Patient of Case 7, *ibid.*, also shows liver margin after treatment had been partially completed.

day and miracidia were last hatched forty-five days following the initial dosage. Before dismissal physical examination showed the liver to have remained in about the same position as at admission, while the spleen had receded 3 cm. toward the costal margin. Weight 62½ lb. The total serum proteins amounted to 8·20 per cent., of which 3·96 per cent. was albumin and 4·24 per cent. serum globulin. R.B.C., 3,032,000; W.B.C., 3,000; eosinophiles, 13 per cent. Two months later the patient returned for re-examination. The weight had reached 70½ lb. The liver was palpable only in the midline. The spleen had receded another 4 cm. R.B.C., 4,848,000; hgb., 60 per cent.; W.B.C., 5,600. Serum globulin precipitation +. Eosinophiles 15 per cent. General appearance and nutrition excellent.

CASE 7 (fig. 6).—S. H. C., age 20, farmer boy from Hupeh Province, was admitted to the hospital March 28, 1924, complaining of " itch " and abdominal discomfort. On examination he was found to be under-developed, with noticeable anæmia and pallor. Height, 4ft. 5in.; weight 67½ lb. Eczema of scalp; eyelids œdematous. Heart normal except for slight systolic murmur at apex. Lungs normal. Abdomen barrel-shaped (" pot-belly "), with a girth of 70·5 cm. at costal margin and 72 cm. at umbilicus. Liver palpable 8 cm. below xiphoid cartilage, 2 cm. below costal margin in left mid-clavicular line and 5 cm. below costal margin in right mid-clavicular line. Consistency, soft. Spleen palpable 5 cm. at greatest perpendicular to left costal margin. Abdominal veins visible.

Laboratory Findings.—R.B.C., 1,832,000; hgb., 43 per cent.; W.B.C., 11,700; neutrophiles, 68 per cent.; eosinophiles, 18 per cent.; lymphocytes, 7 per cent.; large mononuclears, 7 per cent. Serum globulin precipitation +; Wassermann negative. Urine negative. Fæces, eggs of *Schistosoma japonicum* and hookworm. Total serum proteins, 8·92 per cent.; albumin, 4·20 per cent.; serum globulin, 4·72 per cent.

Diagnosis.—Schistosomiasis japonica, hookworm, eczema of scalp.

Therapy (see Table I).—Potassium antimony tartrate treatment was begun on April 7 with an initial dose of 5 c.c. (1 per cent. sol.) and continued for a period of sixty days, during which time 2·005 grm. of the drug were administered. Reaction to the drug began on the third day, when a total of 0·225 grm. had been administered. It became so marked when the total dosage had reached 1·025 grm. that a period of eighteen days was allowed to elapse before further treatment was attempted. During the latter half of the treatment reaction was marked, although the general condition of the patient improved from day to day. The last eggs were found in fæcal smears on the twenty-eighth day and the last miracidia were hatched on the thirty-ninth day following first dose of the drug. The patient was continued under observation until the eighty-third day, when he was dismissed, greatly improved and apparently cured of the infection. Physical examination before dismissal showed a slight increase in weight, 72 lb. General shape improved. Liver and spleen barely palpable on inspiration. Total serum proteins, 8·38 per cent.; albumin, 4·50 per cent.; serum globulin, 3·88 per cent.; R.B.C., 3,064,000; W.B.C., 5,400; neutrophiles, 31 per cent.; basophiles, 1 per cent.; eosinophiles, 43 per cent.; lymphocytes, 2 per cent.; large mononuclears, 20 per cent.; transitionals, 3 per cent. Serum globulin precipitation negative. Fæces positive for hookworm.

DISCUSSION OF DATA PRESENTED.

With the possible exception of Case 4, which represents a slightly earlier stage of infection than the other cases in this series, all of the cases studied denote a single stage of schistosomiasis japonica, a moderately advanced pre-ascitic condition, in which

both liver and spleen are markedly enlarged, in which there is an appreciable secondary anæmia and in which eosinophiles still constitute a considerable fraction of the white blood cells. In this respect they correspond to the majority of Tootell's twenty-six cases from Changteh, Hunan, twelve of which received a course of tartar emetic treatment sufficient to justify Dr. Tootell in the belief that cures had been effected. These are summarized in Table III by the side of the Wuchang cases. They correspond in some degree to certain cases studied by one of us (H.E.M. in Faust and Meleney, 1924, p. 224) in Kashing, Chekiang, in 1923. The case of the American naval officer (Faust and Meleney, *l.c.* p. 236), and the case of a Roumanian gipsy under the care of Dr. C. U. Lee in the Peking Union Medical College Hospital in 1924 (see Table III) both represent incipient infections. Libby's cases of both series (Libby 1923, 1924) constitute groups of advanced schistosomiasis japonica with severe cirrhosis of the liver, usually accompanied with marked ascites. While there are differences in presentation of data of these several groups of cases which do not make a detailed comparison in the symptomatology and treatment of them possible, on the whole they constitute a progressive series from the early incipient type to the last stage of the disease. Some of the data as presented in Table III, if taken out of the case histories, are in conflict with similar data from other groups. However, they represent the only cases treated with tartar emetic in China of which there are sufficient data for comparison. It will therefore be useful to keep this fact in mind in considering the Wuchang cases.

Table III.—Comparative Data on Tartar Emetic Treatment of Schistosomiasis Patients in China.

	American Naval Officer (incipient)	C. U. Lee's case (incipient)	Wuchang cases (moderately advanced)	Tootell's cases (moderately advanced)	Libby (2) (4 advanced cases)	Libby (1) (3 advanced cases)
Rationing of drug used ...	0·1-0·2 grm. each time	0·04-0·1 grm. each time	0·05-0·1 grm. each time	0·01-0·1 grm. each time	0·033-0·156 grm. each time	0·033-0·1 grm. each time
Total drug used	1·8 grm.	2·0 grm.	2 grm. or more	1·2 grm.	1·62 grm.	0·7 grm.
Average number doses ...	12	27	22	15·6	13·5	7·3
Average last egg	0·95 grm.	1·95 grm.*	0·98 grm.	1·2 grm.	0·6 grm.	0·59 grm.
Average hatched miracidia	—	1·45 grm.	1·32 grm.	—	—	—
Average time of last egg after initial dose	9 days	32 days*	21·7 days	?	?	?
Average time of last hatched miracidia	—	22 days	35·5 days	—	—	—
Average time occupied by treatment	17 days	34 days	52 days	37·3 days	35·8 days	40 days
Average interval between doses	1·4 + days	ca. 1·5 days	2·4 days	2·4 days	2·6 + days	5·0 + days

* A few non-viable eggs were passed ten days after miracidia were hatched. Note comment in text.

Physical Findings.

The Wuchang series consists of cases of young male Chinese of approximately the same age (15-25 years) coming from the same region, of the same occupation, and having about the same amount of exposure to this and to other infections. With the exception of Case 4 they represent a similar stage in the infection; and with the exception of Case 4 they were all under-developed. They all had enlarged palpable livers, and all but Case 4 had enlarged spleens.

Careful plotting of the livers and spleens of all seven cases on a diagram chart (fig. 7) after they have been reduced to a common standard shows a marked diversity in size and shape of these organs. The distribution of the palpable liver areas is much more irregular than those of the spleens, although the apices of the latter are much more dispersed than Christophers has found to obtain in malaria spleens in Indian children (Christophers, 1924, p. 109). It is realized that an index based on distance palpable below the costal margin is somewhat variable, depending materially on the chest and abdominal development of the patient and in no less a degree at times on the enlargement of the liver in this disease. Yet the shape and size of liver and spleen differ so considerably in schistosomiasis japonica in cases of the same stage and supposedly of the same degree of infection, that the value of attempting to utilize such an index in this infection is questionable. If we take the livers and spleens of different stages of the disease, and plot them on a common chart (fig. 8) we do not get the simple curve which Christophers secured for his malaria series, but a very greatly dispersed and uncorrelated graph. In other words, although in general there may be some correlation between the size of the liver or spleen and the severity of the infection, such a correlation does not necessarily follow. In fact, Faust and Meleney have shown (*l.c.*, p. 222) that there is frequently an inverse relationship between the sizes of liver and spleen in advanced cases, "which does not vary with the degree of ascites nor with the apparent duration of the disease." They consider "that it is probably related to thrombosis of the portal or splenic vein, and to a combination of other indefinite factors, including the toxæmia of the infection and the early plugging of many portal venules by the eggs of the parasite."

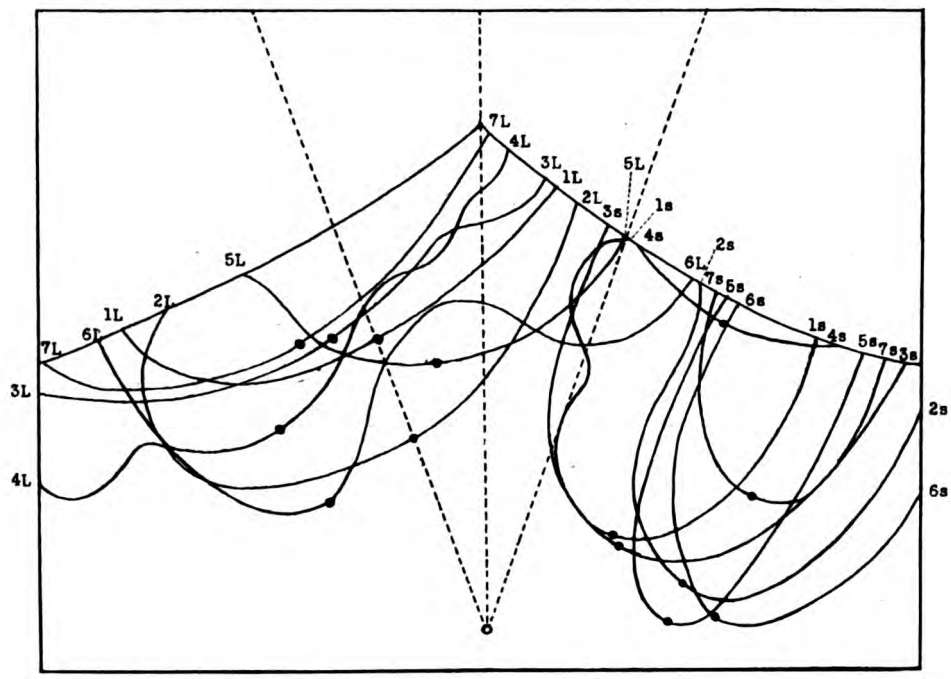


FIG. 7.—Outline of livers and spleens in Wuchang series of seven cases of schistosomiasis japonica. 1L—1L, liver outline of Case 1; 1s—1s, spleen outline of Case 1.

In other words, although ascites represents a late stage in schistosomiasis japonica, the factors involved in the enlargement of the liver and spleen in this disease are so many and at times so complicated that they cannot be expressed in any simple formula or curve.

In all cases, except those with marked ascites, improvement occurred after antimony therapy. There was considerable evidence afforded that in such patients a certain amount of tartar emetic is lethal for the worms in the portal system. However, the destruction of the vital tissues of liver and spleen and replacement by fibrous connective tissue is another matter. If destruction has not been too great, a recession of liver and spleen under the costal margin begins before or soon after the minimum lethal dose for the parasite has been initiated and continues until these organs approach their prediseased normal condition. If, on the other hand, destruction and replacement of vital tissue with fibrous tissue have been profound, little improvement from the condition of cirrhosis resulting from the infection can be expected. *Such patients may be cured of the infection but not of the disease.*

LABORATORY FINDINGS.

(1) *Blood.*—When we turn from the physical finding in schistosomiasis japonica to the laboratory findings, we are confronted with data much more readily correlated.

In the early active stage of the disease in man the percentage of eosinophiles is usually very high. In the case of the American naval officer (*l.c.*) it ranged from 52 to 29 per cent. In Lee's Roumanian

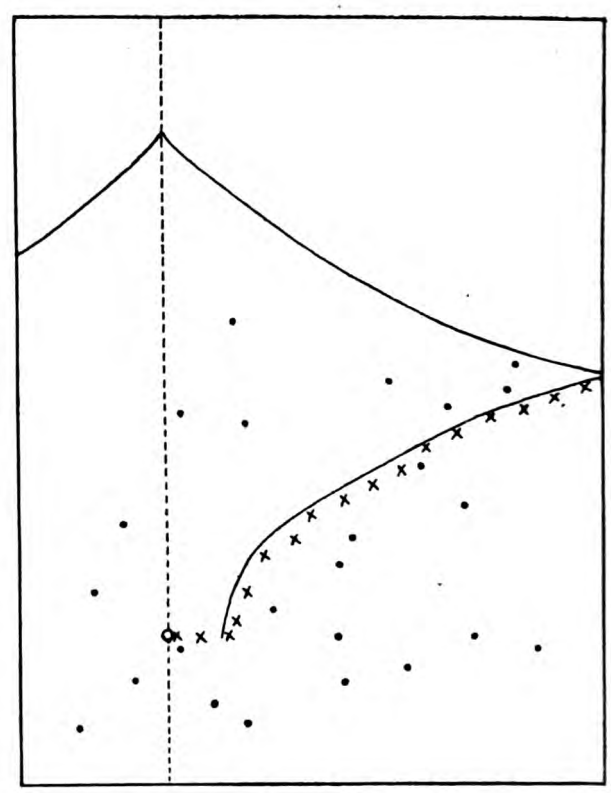


FIG. 8.—Graph showing spleen size in schistosomiasis japonica in comparison with mean average of malaria spleens in Indian children (Christophers' data). •, greatest distance of schistosomiasis spleen from left costal margin; X, *ibid.* for malaria spleens; O, umbilicus.

case it was likewise exceptionally high (from 72 to 27 per cent.). The Wuchang cases, which represent a more advanced stage of the infection, ran from 43 to 10 per cent., with an average of 23·1 per cent. Tootell's cases from Changteh showed from 30 to 9 per cent. eosinophilia, with an average of 13 per cent. The Kashing series (Faust and Meleney, *l.c.* p. 224) had an average eosinophilia of 16·8 per cent. for the early members of the series and 4·3 per cent. for the late ascitic cases. Libby's cases (1924, 386) had an average eosinophilia of 6·4 per cent. Furthermore, while the percentage of these cells may be reduced somewhat as treatment progresses, it remains high for a considerable period after a full course of treatment has been administered. Five members of the Wuchang series, examined three months after treatment was instituted and a month or more after it was completed, had an average eosinophilia of 16·8 per cent. as against 21·2 per cent. before treatment.

While the number of red blood cells and the hæmoglobin percentage are frequently rapidly reduced in schistosomiasis japonica, with attendant clinical signs of secondary anæmia, once the disease has run a course of several months the red blood cells bear little relationship to a particular stage of the infection.[1] The Wuchang series had a R.B.C. ranging from 1,832,000 to 4,120,000, and a hgb. percentage from 37 to 66 (average 46·6 per cent.). The hgb. in Tootell's cases averaged 60·2 per cent.; in Libby's advanced cases it averaged 57 per cent. Nor is the percentage of hæmoglobin necessarily correlated with the number of red cells. In treated cases however, if we may judge from the Wuchang series, the hæmoglobin percentage rises appreciably before the number of red cells increases.

(2) *Serum globulin* (Table II).—Ray's precipitation test for serum globulin (Sia, 1924) varied in the Wuchang series from + + + to negative, although the majority were + +. The total serum proteins of the seven patients on admittance varied from 8·67 to 9·72 per cent., and the serum globulin from 3·78 to 6·55 per cent., with averages for the series of 9·13 and 4·98 per cent. respectively. If we compare these percentages with the Kashing series (Meleney and Wu, 1924, 358) we find somewhat similar figures. It seems more justifiable, however, to divide this latter series of cases into two equal groups: (*a*) moderately early, and (*b*) late. The average total serum proteins for the first half of the series is 8·01 per cent. that for the second half 8·73 per cent. Similarly the serum globulin averages 4·89 per cent. and 6·19 per cent. The highest serum globulin in the case of the American naval officer (Meleney and Wu, *l.c.*, 360) was 3·68 per cent., a lower figure than any member of the Wuchang series and lower than all but three of the Kashing series. On the other hand, the total serum protein of this case was practically the same as that of the average for the Kashing series. On the whole, therefore, but not necessarily in each individual case, the data support the view that there is no important change in the total serum proteins in untreated cases during various stages of the infection, although there is an increase in the serum globulin.

In the case of the American naval officer referred to above there was a marked decrease in the serum globulin on the seventh day of treatment with tartar emetic, but a return later to the original percentage. In our Wuchang series estimates of the total serum proteins in six cases for an average period of sixty-four days following the initial administration of tartar emetic showed a slight diminution in all cases except Case 2. Likewise, a similar estimate on the serum globulin showed a more or less marked decrease in percentage except in Case 2. It seems possible that the condition in this single case can be explained by the positive Wassermann reaction. As improvement takes place in schistosomiasis patients following tartar emetic treatment, there are indications of a reduction in the serum globulin.

(3) *Urine.*—Throughout the series urinalysis was consistently negative for albumin and sugar.

(4) *Fæces.*—The eggs other than those of *Schistosoma japonicum* found in the fæces indicated no heavy infection which could essentially alter the physical condition of the patients or cause marked deviation from normal of the blood picture. In no case was the fæces bloody, as in initial or terminal dysentery or in spontaneous eruptions of a large number of eggs bursting through the intestinal wall. The relationship of the presence of eggs in the stool and of viable miracidia will be discussed under the subject of treatment.

Treatment.

The result of tartar emetic therapy in the Wuchang series was both a success and a disappointment. It was successful in that under carefully controlled conditions it showed that *moderately advanced cases of schistosomiasis japonica can probably be cured.* It was unsuccessful in that it demonstrated clearly that *two grammes of the drug cannot be administered to patients in this stage of the infection within the limit of one month.* In fact, under most favourable financial arrangements for the patients the tedium and discomfort of a complete treatment caused almost as many patients to run away from treatment as actually stayed through a complete course. In Tootell's twelve cases (1924), which he designated as "cured," he gave an average dosage of tartar emetic of 1·2 grm. administered on the average in 15·6 injections; the number of doses covered an average period of 37·3 days. He determined his dosage and spacing of injections in the usual manner by observing the tolerance of the patients and the signs of reaction, and the end point in the treatment by examining stools for five or more successive days and finding them to be negative. Comparison of Tootell's data with similar items in our series (Table III) shows certain points of agreement. We started with a larger initial dosage of the drug,

[1] It is to be expected, of course, that on the average late cases have a more pronounced anæmia than early cases.

but Tootell's cases soon caught up with ours in amounts administered each time. Tootell's treatment of 1·2 grm. covered a slightly longer period than we took to administer a similar amount to our patients (30 days). Our series showed an average last egg recovered by fæcal examination on the twenty-second day after beginning treatment, or at a time when 0·98 grm. of the drug had been administered. *But our hatching of miracidia as a check on the recovery of eggs consistently showed* (compare Table II) *that the absence of eggs in routine smear examinations is an unsafe method of diagnosing "cures."* An average additional dosage amounting to 0·34 grm. covering a period of fourteen more days was administered before hatched miracidia were negative as well as the eggs. *In none of our series have eggs been found after miracidia became negative in washed fæces*, although daily routine examinations were continued until the treatment was completed.

In this connection Dr. C. U. Lee's case (Table III) needs a word of explanation. It appears as if the data relative to the appearance of the last egg and the last hatched miracidia were reversed. The miracidia were hatched in the standard way advocated by Faust and Meleney (1924, p. 218). However, the eggs were examined each time in a more careful way than the ordinary smear method, in case that proved negative. Larger samples of fæces were centrifuged and the sediment carefully examined for eggs. This more thorough search revealed eggs not found in the ordinary way. It may be added, however, that no viable eggs were found after the miracidia failed to hatch. It is evident, therefore, that eggs filter through the intestinal tissues in small numbers after the miracidia have been rendered non-viable. Unfortunately, we cannot state from our present information whether these non-viable ova filtered through the tissues following or preceding the death of the parent worms in the portal system. We *are* able to state, nevertheless, that the "hatched miracidia test" is a much more reliable laboratory method of determining the apparently lethal amount of the drug for the worms than that of searching a fæcal sample for the eggs by the smear method.

It is possible that Tootell's average dosage of 1·2 grm. constitutes a sufficient amount of the drug to kill the worms in incipient or moderately advanced cases. In the five patients of his series which he re-examined a month later, and the one which he re-examined six months later, that would appear to be a correct inference. If such is the case, then the worms are killed before the last viable ova filter through to the intestinal lumen. However, we are inclined to believe that safety lies in a somewhat longer treatment and the administration of a greater amount of the drug. Yet it seems hardly likely that two grammes is required to effect a cure in such cases. If it can be shown by the study of a sufficient number of cases that cures can be effected by the administration of 1·5 grm. of tartar emetic covering a period of about forty-five days, either according to our suggested method of administration or any other feasible one, the patient would be relieved of many of the intoxicating symptoms of the treatment most prominent during the administration of the last 0·5 grm. of the drug.

We believe that Libby's cases (Table III), representing, as they do, an advanced type in which hepatic cirrhosis (with ascites) has proceeded beyond a period of functional recovery of the liver, have little hope from tartar emetic treatment. The marked toxic effects exhibited by the patients during treatment, the reduced dosage necessitated, except in one instance, where grave antimony poisoning resulted in death, and the prolonged interval necessary between injections, all contra-indicate tartar emetic therapy in this stage of the disease. In such cases there is little hope for recovery, even if it were possible to administer enough of the drug to kill the worms. These advanced cases undoubtedly represent a type more grave than any of the cases of schistosomiasis hæmatobia or schistosomiasis mansoni and must be recognized as such. In fine, even in moderately advanced cases of schistosomiasis japonica, tartar emetic is not as simple a procedure as in early cases, and they are surely not as amenable to simple treatment as either vesical or rectal bilharziosis. As schistosomiasis japonica develops the patients tolerate a smaller and smaller amount of the drug at one time, a condition differing from that in kala-azar patients, whose tolerance for the drug is fairly comparable to that of bilharzia patients. A probable explanation for the greater severity of this disease is the far greater fecundity of the female worm, with the correspondingly larger number of eggs extruded into the tissues. It may be that the liver is so severely and extensively damaged by these eggs, even in moderately advanced cases, that poisoning by the drug is induced more readily. It will require longer courses of treatment with smaller doses and longer intervals between doses to cure these cases than is necessary to cure very early ones.

This treatment cannot feasibly be carried on at the present time in China in out-patient clinics on account of the marked reaction of the patient to the drug. However, we are not in a position to advocate the use of other therapeutics in schistosomiasis japonica, since no other drug has been given ever the trial to which tartar emetic has been subjected. The fact that tartar emetic has been proved specific in early and secondary stages of the disease makes it possible to treat such cases as in-patients, but the drug needs to be used with great caution in advanced cases.

Summary and Conclusions.

(1) This study was undertaken: (*a*) To test the reactions of patients suffering from schistosomiasis japonica to intravenous injections of tartar emetic administered in moderately heavy doses; and (*b*) to determine the potency of the drug in killing the parasite responsible for the infection.

(2) A series of seven young males suffering from moderately advanced schistosomiasis japonica was selected and treatment instituted on them as in-patients in the Church General Hospital, Wuchang, China. The data secured embodied (*a*) detailed history and physical examination, (*b*) detailed blood, urine and fæces examinations on admission and throughout the study, (*c*) treatment with tartar emetic up to about 2 grm. or until they were believed to be cured; reaction to the treatment and effect of the drug on the patient, as determined by clinical and laboratory findings.

(3) Although it was proposed to administer the entire amount of the drug within one month, practical experience, based principally on the tolerance of the patient, showed that such a programme was not feasible. About sixty days was found to be necessary for the full treatment.

(4) The hatching of miracidia for an average period of fourteen days after the last eggs of the parasite were found in the fæces by routine smear examination showed that the former method is preferable in estimating the minimum amount of the drug lethal for the parasite. Even this method, however, is not an absolute check, since the parasites in the portal system may still be viable after the laboratory tests are all negative.

(5) In the Wuchang series eggs ceased to appear in routine fæcal smears after an average of twenty-two days, with an average administration of 0·98 grm. of tartar emetic. Miracidia were hatched up to the thirty-sixth day, or until an average of 1·32 grm. of the drug had been given. It is felt that 2 grm. of tartar emetic may be an over-dosage in incipient or moderately advanced cases of schistosomiasis japonica. If 1·5 grm. is found by experience to be sufficient, much of the discomfort of the patient, due to the administration of an additional 0·5 grm., can be avoided.

(6) The series treated gave evidence that tartar emetic treatment in moderately advanced cases of schistosomiasis japonica caused marked improvement and probably cure, as indicated by clinical and laboratory examinations. The blood picture improved, the liver and spleen began to recede, and the general physical condition of the patient showed a decided improvement. Tartar emetic is advocated, therefore, for incipent cases and those of the secondary stage of the infection, but caution in the use of the drug is recommended in cases with advanced cirrhosis and ascites.

ACKNOWLEDGMENTS.

We wish to express our appreciation to the house staff of the Church General Hospital, Wuchang, for their co-operation in our study, and to Dr. C. U. Lee for permission to use some of his data before they are in published form.

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Experimental Amœbiasis in Cats from Acute and Chronic Human Cases (Edna H. Wagener and Margaret D. Thompson, *University of California Publications in Zoology*, Vol. 26, No. 15, 1924).—Attempts have been made to infect kittens with motile amœbas from acute and chronic cases of amœbiasis. One acute dysenteric fæcal specimen produced infection in three kittens, which was carried through six transfers in thirty-three cats. Fourteen attempts to infect kittens with motile amœbas from chronic cases resulted in only one infection which was transferred only once to a young kitten. Amœbas have been found to appear intermittently in the stools from cats with chronic or subacute experimental amœbiasis. Kittens which have been previously injected with motile amœbas were more difficult to infect than normal animals of the same age and size, thus suggesting a possible immunity. No cysts were found in the fæces of infected cats at any time. It has been found impossible to infect guinea pigs and rats by the rectal injection of actively motile amœbas obtained from acute cases of experimental dysentery in kittens. No infections resulted in guinea-pigs which were fed on cysts from human fæces.

Notes on Ocular Epidemiology in Libia (E. Bartolotta, *Arch. Ital. Scienze Med. Coloniali*, February-March, 1924).—The conjunctival diseases occurring in Libia may be classified into: (*a*) catarrhal, (*b*) muco-purulent, (*c*) fibrino-purulent. The catarrhal are of bacillary origin, the muco-purulent are due to staphylococci, and the fibrino-purulent to pneumococci. These never appear in epidemic form at the same time; the catarrhal are observed in spring and early summer, the muco-purulent in summer, and the fibrino-purulent in the autumn and early winter. In the very cold and rainy months these infections do not appear at all. It is interesting to note that fair people are more susceptible than dark, but no race is exempt from the disease.

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APRIL 15, 1925.

A WHITE AUSTRALIA: IS IT A POSSIBILITY?

By SYDNEY J. SKERTCHLEY, J.P.

(*Continued from page* 142.)

CHAPTER XI

Natural Rate of Increase.

(173) By the natural increase of a population is meant the excess of births over deaths. Where immigration is not a factor, this represents the numbers given in census returns, but where, as in Australia and the United States, immigration is a considerable item, it must be carefully and separately dealt with. It has, I trust, been overwhelmingly demonstrated that no land can hold its own if it depend solely on immigration. The East and West Indies show this unmistakably, and we have seen that even in the United States immigration has not had the effect so fondly anticipated by the early statisticians. Moreover, no country can stand the continual strain of immigration, and we have shown how the European source of supply shows strong signs of depletion, and has only been maintained of late by the artificial stimulus of interested advertisement. It behoves us, then, to examine carefully both our rate of natural increase and our immigration returns. These last can only be approximately estimated by taking the excess of arrivals over departures, but the resulting figures are sufficiently near the truth for our purpose.

(174) Now the natural increase depends not only upon the birth-rate, but upon the death-rate also. Where the death-rate is low (that is when the country is healthy, or otherwise conducive to longevity) we may have a high rate of increase with a low birth-rate. This is what happens in the Commonwealth. "Notwithstanding its comparatively low birth-rate, Australia has a high rate of natural increase, owing to the fact that its death-rate is a very low one."

(175) This is a most important fact, and we must deal with it in some detail. For various reasons it is only possible to deal with what is technically called the crude birth-rate, that is, the number of births per 1,000 of the mean annual population. This rate for the Commonwealth has been as follows:—

1901	27·14
1902	26·66
1903	26·23
1904	26 33
1905	26·12
1906	26·81
1907	26·55

This birth-rate is lower than that of any European countries, except Scandinavia, Belgium, and France; the rate for England, for example, is 27·1, while for Russia it is as high as 47·9. But this is to some degree compensated by the low Australian death-rate, which in 1907 was only 10·9, as against 15·6 for the United Kingdom.

(176) The result of the combined low birth-rate with a low death-rate is to give the Commonwealth a natural increase of 15·0, as against 12·13 for England and Wales. The actual increase varies between 18·4 for Western Australia and 12·67 for Victoria, that for Queensland being 15·63. So far, then, as natural increase is concerned we seem to have nothing to complain of. But, alas, this is a misreading of the evidence. Hear what Mr. Knibbs has to say upon the matter. Under a special heading he calls serious attention to the "unsatisfactory nature of the Commonwealth rate."

(177) "The annual rate of increase in the Commonwealth population for the quinquennium 1901-6 was

practically identical with the annual rate for Germany, the figures being respectively 1·49 per cent. and 1·47 per cent. In view of the sparsity of the population of Australia and the recency of its settlement, this rate of increase, equal only to that of such a densely populated country as Germany, cannot be regarded as satisfactory. When contrasted with the growth of population in the United States the comparison is even less favourable, since the annual rate of increase of that country for the period 1901-6 was 1·62 per cent. Further, if the increase in the population of the Commonwealth be compared with that of the United States under comparable conditions as to density of population, it will be seen that whilst during the seventy years 1790-1860 the population of the United States increased at a rate of slightly more than 3 per cent. per annum, that of the Commonwealth has, in the past ten years, grown at less than half that rate. The full significance of the difference between these two rates of increase will be seen on comparing the figures shown in line (*a*) below with those appearing in line (*b*). The former represent the population of the Commonwealth in the years specified, on the assumption that the rate of increase experienced in the Commonwealth during the past ten years remains permanently in force, while the latter show what it would be in the same years if the rate of increase experienced in the United States during the seventy years, 1790-1860, were in force.

SIGNIFICANCE OF PRESENT RATE OF GROWTH OF COMMONWEALTH POPULATION.

	Dec. 31 1907	Dec. 31 1908	Dec. 31 1909	Dec. 31 1910	Dec. 31 1920	Dec. 31 1930	Dec. 31 1940	Dec. 31 1950
(*a*)	4,197,037	4,260,000	4,324,000	4,388,000	5,091,000	5,906,000	6,852,000	7,949,000
(*b*)	4,197,037	4,324,000	4,454,000	4,588,000	6,176,000	8,321,000	11,188,000	15,058,000

(*a*) On basis of Commonwealth rate of increase, 1898-1907.
(*b*) On basis of U.S.A. rates of increase, 1790-1860.

"These are not predictions as to the probable future population of the Commonwealth, but computations showing what the population will be if only the present rate of increase is maintained, and what it would be if the increase were as rapid as in the United States at a comparable period."

(178) Now this is one of the most remarkable and important official statements ever made with respect to the population of Australia. It is the deliberate finding of an accomplished statistician who has at command the most complete details. I confess my own investigations, though pointing to a similar general result, hardly led me to see the problem in so grim a light.

(179) But the amazing point is that Mr. Knibbs should have selected the United States for comparison, as I had done in the previous article (pars. 138-166). But, whereas Mr. Knibbs saw in the United States an increase that, he grieves, seems hopeless for Australia. I, from the same evidence, proved that the rate in the United States was a falling one, and threatened the extinction of the Fair Whites. Now, if the case of the United States is so alarming to her own people, and if the case of the Commonwealth is so much worse that our cousins' condition looks rosy in comparison, what in all sober earnest becomes of the cry "Australia for the Australians"?

(180) Nor is this putting the case at its strongest. It may be argued that after all we may rely upon immigration to keep our ranks full, even if our cradles are comparatively empty. We will see how this works out in practice. It has already been shown that no country can stand a continual drain of its populace, and that the tide of emigration, though bolstered up by artificial stimuli, is ebbing rapidly. But we will cede these points and ask whether Australia has proved, and is proving, the tempting lure that many conscientiously believe to be the case.

(181) There is plenty of room for expansion in Australia—the land is by no means overcrowded. Again let Mr. Knibbs speak. "From one aspect population may be less significant in respect of its absolute amount than in respect of the density of its distribution. The Commonwealth of Australia, with an area of 2,974,581 square miles, and a population on 31st December, 1907, of 4,197,037, has a density of only 1·41 persons to the square mile, and is, therefore, the most sparsely populated of the civilized countries of the world. For the other continents the densities are approximately as follows: Europe, 111; Asia, 55; Africa, 13; America, 10. The population of the Commonwealth has thus about 14 per cent. of the density of that of America, about 11 per cent. of that of Africa, about 2½ per cent. of that of Asia, and about 1¼ per cent. of that of Europe." This mode of stating the case is a just one. It cannot be claimed as a set-off that much of Australia is uninhabitable desert, for the same is true of Africa and Asia, and to a lesser degree of America. How, then, have our immigrants fared?

(182) During the forty-seven years, 1861-1907, there was a net excess of arrivals amounting to 784,982 persons. That is 26 per cent. of the increase has been due to net immigration, and 74 per cent. to natural increase. The immigrant increase has not been equally spread over the States of the Commonwealth, for during the period in question, the departures from Tasmania and Victoria have exceeded the arrivals, in the former case by 12,488, in the latter by 26,713. Indeed in all the States there have been quinquennial periods in which the departures have exceeded the arrivals; in New South Wales and Queensland in 1881-5; Victoria in 1886-90; South Australia in 1876 80; in Western Australia and Tasmania in 1896-90. Again let me cite Mr. Knibbs.

(183) "During the twenty-six years, 1881-1907 the annual rate of increase in the population of the

Commonwealth has exhibited a marked decline, falling from an average of 3·86 per cent. for the five years 1881-6 to an average of 1·49 for 1901-6, the rate for the latter period being also the average for the five years 1891-6. A slight improvement took place in 1907."

(184). Now what do these fluctuations of immigration show? There seems to me to be but one answer. In spite of the mining and other booms that have done so much for Australia, in spite of her exquisite climate, in spite of her fertile and cheap lands, Australia has not been able to attach her immigrants to her soil as firmly as America has done. There we have no parallel to the fluctuating wave across the sea. Victoria and Tasmania, the most home-like of the States, have sent more people from their shores than they have received, and so slender is the hold of the remaining States that at the touch of drought or commercial depression the new comers take flight. The native Australian cannot keep up the natural increase; the immigrant does not.

(185). Even this does not fully represent the seriousness of the result of this investigation. We have still to consider the effects of our tropical regions upon the stamina of the people, and the truly alarming and unparalleled tendency of the Australian to congregate in towns instead of diffusing over the wide and life-giving country, in which alone lies, in my belief, the possibility of there being a permanent white Australia at all. This will be the subject of my next, and last, article.

Annotations.

Treatment for Tapeworms (H. Iacobaeus, *Ugeskrift f. Laeger*, 1924).—The writer has been in charge of an 85-bed hospital in Copenhagen for twenty-one years, during which time 132 cases of tapeworms have been treated, most of which were due to infection with the *Tænia mediocanellata*. There was no case with *T. solium* and only seven with *Bothriocephalus latus*. Up to 1869 *T. solium* was very common in Denmark, but it has since gradually died out. In one case three large specimens of the *B. latus* were found in the same host, and in another case there were two specimens of *T. mediocanellata* in the same host; the latter is a very rare occurrence. In several of the writer's cases of *T. mediocanellata* there were none of the classical symptoms of tapeworm infection, and in only a few was there some emaciation. Bothriocephalus may cause severe anæmia and should be treated immediately; it is easily expelled. In the case of *T. mediocanellata* active treatment is not urgent, and if there are complications such as pregnancy, treatment should be deferred till the complications no longer exist. About 100 cases have been reported of serious impairment of vision following administration of filix mas; mostly observed in South Germany and Switzerland. Although this drug is used extensively in Scandinavian countries, especially in Finland, no cases of amaurosis have been recorded. Negative results with the treatment of filix mas are generally due to inferior quality of the drug.

Malaria in Rural Settlements in Palestine. Incidence and Etiology of Malaria (I. J. Kligler, *Journal of Hygiene*, December, 1924).—Statistical and laboratory data are presented, which bear on the incidence and epidemiology of malaria in rural Palestine. These data indicate that the annual incidence of malaria ranged between 50 and 100 per cent., and that in the areas where no control was effected in 1922 it was always considerably higher than the minimum figure. They also show that malaria is both endemic and epidemic and that there are two epidemic periods, one in the summer and one in the fall of the year. In the winter and spring there is little or no primary malaria. The parasites most frequently encountered are *P. vivax* and *P. falciparum; P. malariæ* is uncommon. The *P. vivax* is found throughout the year, but constitutes about ninety-eight per cent. of the total malarias in February to June and only fifty to sixty per cent. during October to December.

The Treatment of Multiple Sclerosis with Silver-Salvarsan (H. Schafgen, *Deut. Med. Woch.*, 1924).—The author has found silver salvarsan the most effective remedy in cases of multiple sclerosis. Twenty-one typical cases with a negative Wassermann have been treated. The first dose was 0·05 grm. twice a week; this was gradually increased to 0·15 or 0·2 grm., the average total dose being 2·5 grm. In thirteen of these cases definite objective improvement was observed. During the past twenty years the author has treated 135 cases of multiple sclerosis with various remedies in his hospital, and the results obtained with silver salvarsan are by far the best.

Medical News.

THE UNIVERSITY OF LIVERPOOL.

EXAMINATION LIST, APRIL, 1925.

Diploma in Tropical Medicine.—J. Black, M.B., Ch.B.; E. J. Crawford, M.B., Ch.B.; Mary W. Ellam, M.B., Ch.B.; F. N. Green, M.B., B.Ch., L.R.C.P., M.R.C.S.; J. T. Johnson, M.B., Ch.B.; Elizabeth K. Mackay, L.R.C.P., M.R.C.S.; K. S. Shah, M.B., B.S.; C. H. B. Thompson, L.R.C.P., M.R.C.S.; J. J. de Waal, L.R.C.P. & S., L.R.F.P. & S.

Recommended for A. H. Milne Medal.—Dr. Shah.

THE new edition of Macmillan's "Tropical Gardening and Planting" has just been published, and copies can be obtained from Messrs. John Bale, Sons and Danielsson, Ltd., 83-91, Great Titchfield Street, London, W.1, price 39s., post free.

Original Communications.

STUDIES OF YELLOW FEVER IN VERA CRUZ IN 1920-1921.

By THOMAS J. LEBLANC, A.B., M.S.P.H., C.P.H., Sc.D.

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I.—ISOLATION OF LEPTOSPIRA ICTEROIDES.

During the epidemic of yellow fever which occurred in Vera Cruz in 1920-21, the opportunity presented itself to carry out some experiments on the transmission of yellow fever from human cases to guinea-pigs and the isolation of *L. icteroides*, which had been obtained from cases of yellow fever in Guayaquil, Ecuador, by Noguchi in 1919 [1], in Merida, Mexico [2], and in Northern Peru [3] by Noguchi and Kligler in 1919-20, and by Pérez Grovas [4] in Vera Cruz in the summer of 1920. The experiments extended over the period from December, 1920, to April, 1921. The Federal Department of Health of Mexico co-operated in the work, furnishing a laboratory for the purpose of the experiments. Special acknowledgments are due Dr. G. Cassasús, representative of the Federal Department of Health, for his co-operation in the matter of immediate laboratory facilities and assistants, and to Dr. M. Loyo, head of the Hospital Beneficia Español, for his unfailing interest and generous assistance on the clinical aspect of the cases studied. The writer is deeply indebted to Dr. Hideyo Noguchi, of the Rockefeller Institute for Medical Research, for his kind assistance and wise counsel, without which this work would have been impossible. The necessary laboratory materials and animals (young guinea-pigs weighing 250 to 300 grm.) were brought from New York.

Upon arrival in Vera Cruz it was found that the epidemic was about at an end, and there remained few suitable (i.e., early) cases of yellow fever for use in transmission experiments. In all, seven cases were used for transmission experiments. Of these one (Case 9) was indefinite as to the stage and questionable as to diagnosis; two others (Case 1 and Case 3) were in the fourth and fifth day of the disease respectively. Of the remaining four cases, three (Cases 2, 5, and 8) were in the third day and one (Case 4) in the second day. If we consider the third day after the date of onset as the limit of time during which the case is favourable for transmission, it is seen that out of the seven cases studied, four may be considered as in that class. Of these four, Case 1 gave an encouraging reaction in one guinea-pig injected with blood from the case, and Case 2 resulted in a positive transmission with the recovery of a culture (Chart I). These two cases will be reported in some detail.

Case History, Case 1, D.B.M. (Chart III).

Male, 32 years of age. Nationality, Mexican. Occupation, civil engineer. Home, Jalapa. Arrived in Vera Cruz on or about November 20, 1920. Sickness began on the evening of Saturday, November 27, with violent pains in back, head and calves, attended by a temperature of 104° F. Was seen by Dr. Loyo on Sunday, November 28, at 6.30 p.m., at which time he prescribed calomel in ten doses of one centigram each, a dose taken every half-hour, and the ten doses to be followed by two ounces of castor oil. The patient had violent fits of vomiting all day Sunday. The material expelled was a yellow, bitter, foul-smelling fluid. No food was taken from the beginning of the illness.

On Monday, November 29, at 8.30 a.m., the face was flushed and congested, the conjunctivæ injected, and jaundice was beginning to appear. The patient experienced some difficulty in breathing, and the breath was foul-smelling. He seemed restless, with shining eyes, and appeared very alert, mentally. On Monday, at 3 p.m., he seemed worse.

The shutters had been drawn at the request of the patient, who had exhibited some photophobia. At this time it was deemed advisable to remove him to the hospital. The case was clear, and was diagnosed as yellow fever by Dr. Loyo and confirmed by Dr. Cassasús. Blood was withdrawn for use in transmission experiments. At the same time 5 c.c. of Noguchi serum was given. The small amount is explained by the attending physician's fear of a reaction. No reaction followed. On Tuesday, at 3 a.m., an additional 30 c.c. of serum was given, and at 7 p.m. of the same date another dose of 40 c.c. There was an apparent improvement. The vomiting lessened and the soreness left the abdomen. The pulse became regular and well defined, and the pains in the head and back lessened. The general appearance of the patient seemed much improved. Later the patient became weak and had periods of delirium. At the hospital the urine collected in twelve hours was 100 c.c. Previous urine collections were impossible because of bowel movements, which had occurred about one per hour; the stools were green, greenish-yellow, or yellow in colour. Albumin in the urine was marked from the beginning of observation; there was no pigment. On Tuesday afternoon the pulse became weak, and an injection was given of 100 c.c. of 0·9 per cent. saline containing 1·0 c.c. of 1:1,000 adrenalin. The heart responded temporarily. The same procedure was repeated on Wednesday p.m., with a response from the heart that lasted for about two hours. The pulse then became fainter and fainter. At 6 a.m. on Thursday the pulse was undefined, and the patient died in a coma at 8 a.m. Permission for autopsy was not granted.

At the time blood was withdrawn it was realized that the case was by no means favourable for transmission purposes, since it had reached too advanced a stage, but since the epidemic was nearing an end it was thought necessary to take advantage of every opportunity that presented itself.

Case History, Case 2, L. S. (Chart III).

Male, age 19 years. Nationality, Spaniard. Residence in Vera Cruz for one year. Occupation, waiter in a canteen, which was next door to the rooming house where Case 1 developed. Illness began after the evening meal on the night of December 7 with a chill, followed by fever, severe pains in the head and general malaise. On the eighth the pains had extended to the back and legs, and on the ninth he was removed to the hospital. The pains had decreased somewhat, the face was flushed and congested, especially in the region about the mouth, conjunctivæ injected, patient restless and excited. At 6 p.m. on the ninth he was seen by Dr. T. C. Lyster. At this time the breathing was catchy and irregular. Diagnosis of yellow fever was made by Dr. Lyster and confirmed by Drs. B. Caldwell, M. Loyo and G. Cassasús. All agreed that it was a very severe case. At this time blood was withdrawn for transmission experiments, and 20 c.c. of Noguchi serum given. There was a slight reaction indicated by scratching of the face and neck and persistent sneezing. The serum produced a favourable change in the pulse and temperature. Eight hours later an additional 20 c.c. was given, with no reaction as in the first dose, but a like favourable reaction on the temperature and pulse. At this stage there appeared tenderness in the epigastrium. The general condition of the

patient had improved, the breathing was regular, and the state of excitement had passed. On the afternoon of the tenth a third dose of 20 c.c. was given, which was followed by a still greater improvement in the pulse and temperature.

Upon entering the hospital there was a trace of albumin in the urine with nitric acid. On the second day the albumin was pronounced in 200 c.c. of urine voided during the night. The routine of the hospital called for only a qualitative test with an estimation of the quantity by the doctor in charge. On the third day there was an increase in albumin, about the same amount of urine being voided. On this day there was a severe black vomit and bleeding from the nose and gums. After the third day the urine increased steadily with a decrease in the amount of albumin present, as well as a decrease in the bile pigments that had been present at this time. His condition steadily improved, and he was discharged as cured on December 24.

Experiments with Blood from Case 1.

While the guinea-pigs inoculated with blood from Case 1 were very promising, as the protocols show, on subsequent passage to new animals the latter either succumbed to bacterial infection or showed no noteworthy reaction. A third passage gave entirely negative results.

Guinea-pig 3.—Inoculated intraperitoneally on December 1, 1920, with 2 c.c. of blood from Case 1. Temperature 105° F. on December 6 and 104·2° F. on December 8. No further symptoms developed, and the animal was killed for examination and passage on December 8. The lungs were slightly congested and contained a few scattered but well-defined hæmorrhagic foci, the liver was markedly pale, showing some icterus, the spleen normal, the kidney enlarged and congested. The blood-vessels of the stomach were congested, especially near the cardiac end. The subcutaneous tissues had a faint yellow tinge. There was considerable albumin in the urine. No leptospira could be demonstrated either in the heart blood or in suspension of liver and kidney.

Guinea-pig 4.—Duplicate of foregoing experiment. No fever or other symptoms. When killed December 30 for examination, a few old hæmorrhagic foci were found in the lungs.

Guinea-pigs 9, 10 and 11 were inoculated December 9, 1920, each with 4 c.c. of liver suspension from guinea-pig 3. Guinea-pig 9 died within twenty-four hours of secondary bacterial infection. The others showed no reaction.

Experiments with Blood from Case 2.

While guinea-pig 12, inoculated with material from Case 2, did not present nearly so promising a picture as had guinea-pig 3 from Case 1, and a comparatively long period elapsed before a reaction was evident, passage to guinea-pig 26 gave encouraging results. The animal was undoubtedly sick and the autopsy findings were clearer and more evenly distributed, i.e., more organs were involved in the changes. Because of the dark brown colour of the animal, there was some doubt whether the yellow tint observed was a true jaundice. Passage was made from this animal to a white guinea-pig, No. 34, which showed undoubted jaundice. Of the seven

CHART 1.

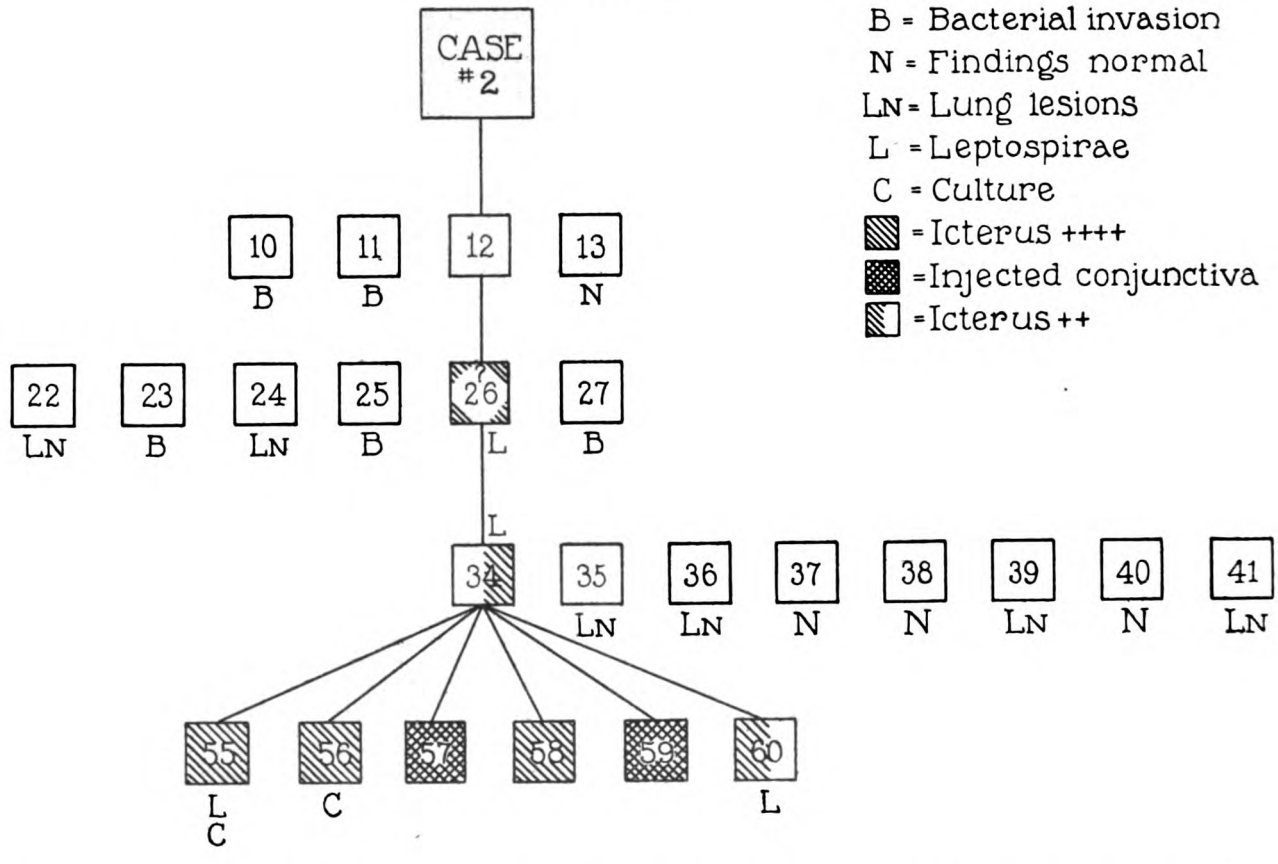
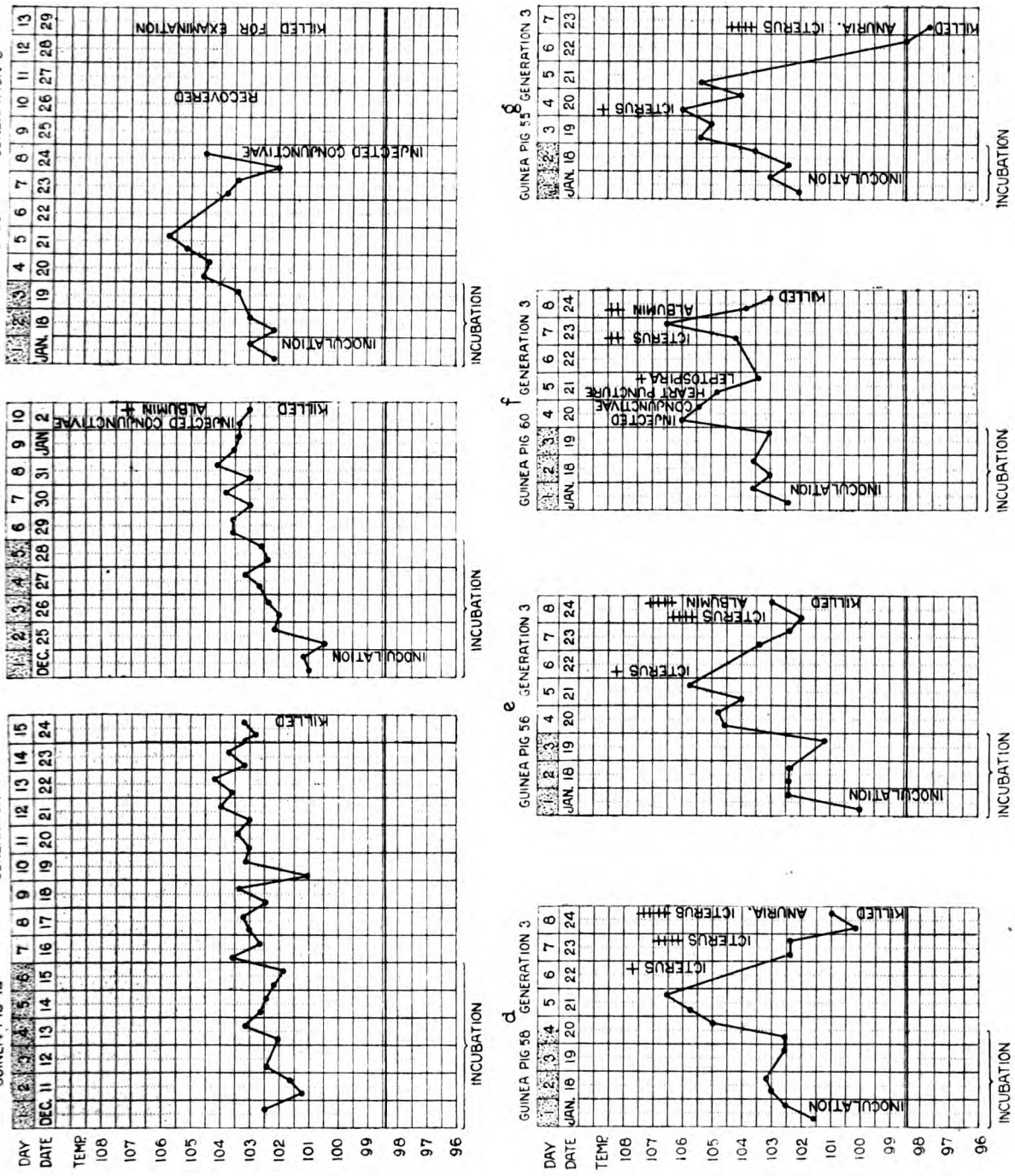


CHART II.

TRANSMISSION WITH BLOOD OF CASE 2



other animals similarly inoculated, four apparently passed through extremely mild infection, as evidenced by the presence of foci of hæmorrhage in the lungs on later examination, while three were entirely negative. On the third passage (transfers from guinea-pig 34), all the animals inoculated developed typical yellow fever, some showing more pronounced jaundice than others. The reaction was prompt, clear cut, and unmistakable. The icterus is noted on the chart as + + + + (Chart I), meaning that the animal was intensely jaundiced, eyes, skin, ears, and paws being the colour of butter.

Subsequent passages gave typical reactions in every instance, and while the minimum lethal dose was not determined, the strain attained a fair degree of virulence for guinea-pigs. In the instances in which demonstration of *L. icteroides* was not successful in the third passage, failure was undoubtedly due to the fact that the animals were allowed to live too long. This was done for the benefit of visiting physicians, that they might see the marked pathological picture of experimental yellow fever in guinea-pigs, the essential features of which are: fever (104° to 106° F.) after an incubation period of three to six days, occasionally two days' jaundice, appearing usually at the height of fever, three to five days after onset, an abrupt fall of temperature succeeding the jaundice, decrease in the amount of urine, accompanied by the presence of albumin and casts in the urine, often complete anuria. Autopsy reveals hæmorrhages of the gastro-intestinal tract and in the lungs, and fatty degeneration of liver and kidney. The spleen is never enlarged in uncomplicated infection.

Guinea-pig 12 (*a* Chart II), inoculated intraperitoneally December 9, 1920, with 3 c.c. citrated blood from Case 2 on the second day of illness. The animal had no reaction for six days, then the temperature rose to 103° F. in the afternoon; the animal was quiet in the cage and did not eat. As the chart shows, the temperature took the form of a gradually ascending curve, reaching a maximum of 104·2° on December 22, when the animal was killed for examination and transfer.

Autopsy.—Clear-cut hæmorrhagic foci in the lungs, with well-defined borders, usually triangular in shape, averaging about 2 mm. on a side. There were seven such hæmorrhages in the left and five in the right lung, and in addition numerous small pin-point hæmorrhages. The liver was markedly congested, the stomach congested, with blood-vessels injected, and the wall near the cardiac end appearing darker than normal. The intestines presented somewhat the same picture as the stomach, but less marked. The kidneys were swollen and congested, spleen normal, bladder empty. No leptospira could be demonstrated. Heart blood was sterile in control broth cultures. Passage was made to guinea-pigs 22 to 27.

Guinea-pig 13. — Duplicate experiment. This animal had no reaction.

Transfers from Guinea-pig 12. I Passage.

Guinea-pig 26 (*b* Chart II), inoculated intraperitoneally December 24, 1920, with 1·5 c.c. citrated blood from guinea-pig 12. At the end of five days the temperature rose to 103·8° F., the next day to 104·2°. The animal was quiet and had no appetite. The temperature began to fall at this point, and the animal was killed for examination.

Autopsy.—Liver pale, especially near the edges of the lobes, making them sharply demarcated. Stomach filled with undigested food; vessels injected; one small hæmorrhagic area near the cardiac end. Intestines congested but with no macroscopic lesions. Kidneys swollen and apparently degenerated; adrenals congested. Lungs pale and contained fifteen to twenty characteristic hæmorrhagic areas, especially near the bases. Urine scanty; what could be recovered contained casts and albumin. A noticeable characteristic of both liver and kidney was their friability; both were easily broken or torn.

No leptospira could be demonstrated in the heart blood, which, however, was sterile in broth control cultures. Three leptospiras were found in the suspension of liver and kidney. The preparations were shown to Dr. Iglesias, head of the laboratories of the Campaña contra la Fiebre Amarilla, who confirmed the finding. Fifteen tubes of leptospira medium were inoculated with the material, but at the end of three days twelve of them showed bacterial contamination, and the remaining three contained neither leptospiras nor bacteria. Passage was made to guinea-pigs 34 to 41.

Of the other animals inoculated with material from guinea-pig 12, one (guinea-pig 22) probably had a mild attack of yellow fever. It had received 1 c.c. of blood intraperitoneally on December 24. On January 3 its temperature was 104·4° F., and on January 7 it was 104° F. There were no other symptoms, but when the animal was killed on January 22 for examination, four old hæmorrhagic foci were found at the base of the left lung, about 2 mm. in diameter, and numerous pin-point hæmorrhages scattered through the right lung. Guinea-pigs 23 and 27 were lost through secondary bacterial infection. Guinea-pig 24 had no reaction, and guinea-pig 25 had a period of irregular fever and died in the night; *post-mortem* changes made it impossible to determine the cause of death in this animal.

Transfers from Guinea-pig 26. II Passage.

Guinea-pig 34.—Inoculated intraperitoneally January 2, 1921, with 1 c.c. citrated blood from guinea-pig 26. At the end of four days the temperature rose to 103·8° F., and continued high until three days later it reached 104·4°, and icterus was noted. Icterus increased for two days, until the eyes were fairly yellow, and the soles of the feet had begun to lose their pinkness, when it began to decrease, and the animal was apparently recovering. It was killed on the thirteenth day after inoculation for examination and transfers.

Autopsy.—Subcutaneous tissue slightly tinged with yellow. Liver friable and the colour of caramel. Kidneys swollen and about one and a half times normal size; tissue easily broken. Adrenals enlarged and markedly congested. Lungs pale, with a yellowish tint, and filled with characteristic hæmorrhagic areas in the wall, irregular in shape, and about 3 mm. in diameter. Stomach filled with dark fluid, viscous and foul-smelling; wall showed three irregular hæmorrhagic areas, about 3 mm. in diameter. Intestines intensely congested, filled with dark contents, and having many pin-point hæmorrhages in the wall. No urine available. Leptospiras were demonstrated in the heart blood and in the suspension of liver. Twelve tubes were inoculated with heart blood, but after four days they all showed the presence of molds.

Guinea-pigs 35 and 36 showed no fever or other symptoms, but when they were killed later for examination, a few hæmorrhagic foci were found in the lungs. Guinea-pigs 37, 38 and 40 had no reaction

and were negative when killed for examination. Guinea-pig 39 had fever (104° F.) for one day but no other symptoms; the lungs showed the characteristic hæmorrhagic foci when the animal was killed two weeks later. A similar picture, but less characteristic, was seen in guinea-pig 41.

Transfers from Guinea-pig 34. *III Passage.*

Guinea-pig 55 (*g* Chart II).—Inoculated intraperitoneally January 17, 1921, with 2 c.c. liver suspension from guinea-pig 34. Temperature 105·4° F. on the third day, 106° F. on the fourth day, after inoculation. Icterus developed on the fourth day and increased in intensity until the seventh day, when it was very intense (+ + + +). At this time the temperature fell to 97·6° F., and the animal was killed.

Autopsy.—Subcutaneous hæmorrhagic areas over the abdominal wall. Pectoral muscles on the right side intensely hæmorrhagic. Liver coffee-coloured, with mottled appearance. Kidneys about twice normal size and brownish-grey in colour. Adrenals swollen and congested. Stomach contained some undigested food, and the contents were dark greyish brown in colour; hæmorrhagic foci in the wall, especially in posterior part. Intestines filled with material much like that of the stomach; walls showed a number of hæmorrhagic foci about the size of a pin-head. Spleen normal. Lungs light cream colour and peppered with reddish brown, irregular hæmorrhagic foci extending throughout both lungs and up into the apices. No urine available. Leptospiras were demonstrated in the heart blood, and twelve tubes of culture medium were inoculated. Six of these escaped contamination, and after eight days five of them showed leptospiras.

Guinea-pig 56, inoculated intraperitoneally January 17, 1921, with 1·5 c.c. of liver suspension from guinea-pig 34. On the fourth day the temperature rose to 104·8° F. and on the fifth day to 105·8°. Icterus appeared on the sixth day and was intense (+ + + +) by the eighth day. At this time it was killed for examination.

Autopsy.—Subcutaneous tissues hæmorrhagic. Liver yellowish brown; mottled. Kidneys double the normal size; adrenals congested and enlarged. Stomach and intestines presented the same picture as guinea-pig 55. Spleen normal. The small amount of urine available was filled with casts and gave a heavy precipitate of albumin with Esbach's reagent. Lungs light yellow, filled with hæmorrhagic areas. No leptospiras could be demonstrated in the heart blood or in suspensions of the liver and kidney. Twelve tubes of leptospira medium were inoculated with heart blood, and at the end of seven days four of the eight tubes remaining free from bacteria showed leptospiras. The other four were negative.

Guinea-pig 57.—Duplicate of foregoing experiment. On the third day the temperature rose to 104·4° F., on the fourth to 105·4° F., on the fifth to 106° F. The conjunctivæ became injected on the seventh day, and were in the same condition on the eighth day, but no icterus could be observed. From this time the condition of the animal improved, and after twelve days observation it was killed for examination.

Autopsy.—Two characteristic foci of hæmorrhage in the right lung and three in the left. All other organs normal.

Guinea-pig 58 (*d* Chart II).—Duplicate of foregoing experiment. Temperature 105·4° F. on the fourth day, 106·6° on the fifth day. Icterus + + on the sixth, + + + + on the seventh day (eyes, ears, paws, and skin over abdomen all intensely yellow). Icterus still intense on the eighth day, temperature 101° F., animal killed for examination.

Autopsy.—Everything typical of an intense infection, the picture being essentially the same as that in guinea-pig 56. Bladder empty. No leptospira could be demonstrated in the heart blood nor in suspensions of liver or kidney. Broth control cultures of heart blood remained sterile. Six tubes of leptospira medium were inoculated with heart blood, but no growth of leptospira appeared in any of them.

Guinea-pig 59 (*c* Chart II), received 1·5 c.c. kidney suspension from guinea-pig 34 intraperitoneally on January 17. Temperature 104·6° F. on the fourth day, 105·6° F. on the fifth day, after inoculation. During the following two days it dropped, then rose to 104·6° F. At this time the conjunctivæ became markedly congested, but no icterus was observed. The animal was killed for examination January 29.

Autopsy.—Lungs showed characteristic hæmorrhagic foci, especially near the bases, averaging 3 to 4 mm. on a side. No gross evidence of change in other organs.

Guinea-pig 60 (*f* Chart II), received 2 c.c. kidney suspension from guinea-pig 34 intraperitoneally on January 17. At the end of the fourth day after inoculation the temperature rose to 106° F., and the conjunctivæ became injected. The temperature remained high for four days, and icterus developed to an intensity of + +. Heart puncture made on the fifth day revealed the presence of numerous leptospiras (one in every three or four fields). The finding was confirmed by Drs. Loyo, Cassasús, Iglesias, and Morfín. On the eighth day the animal was killed for examination.

Autopsy.—Everything typical of a moderately severe infection. Skin yellow, with some subcutaneous hæmorrhages. Liver pale, greyish brown, and easily broken. Kidneys enlarged, yellowish grey in colour. Adrenals hyperæmic. Stomach congested and showing two hæmorrhagic areas. Intestines congested; fairly numerous pinpoint hæmorrhages. Lungs yellowish pink, peppered with hæmorrhages. Bladder contained small quantity of urine, in which casts were found, and albmuin was demonstrated by Esbach's reagent. No leptospiras could be demonstrated in the heart blood or in suspensions of liver, kidney, or adrenals, notwithstanding they had been numerous in the heart blood on the fifth day, and cultures remained negative.

The culture obtained by inoculation of leptospira medium with heart blood of guinea-pig 55 was inoculated into guinea-pigs 62, 63 and 64. Although there was a concomitant paratyphoid infection in two of these animals, as shown by enlargement of liver and spleen, the *icteroides* infection was predominant, and in only one instance did the changes due to the paratyphoid bacillus obscure those caused by the leptospira. The leptospira was recovered from two of the three animals.

Guinea-pig 62, inoculated with 1 c.c. culture intraperitoneally on February 11, 1921. February 15, temperature 104·6° F. February 16, temperature 103·4° F. a.m., 102·6° F. p.m., icterus +. February 1, icterus + + + +; animal killed for examination.

Autopsy.—Skin and subcutaneous tissues canary yellow, vessels injected, some small hæmorrhagic areas over thorax and abdomen. Lungs peppered with small characteristic

hæmorrhagic spots, dark brown in colour, remainder of lung cream colour. Liver greatly enlarged, friable, and reddish brown in colour. Stomach mucosa hæmorrhagic, especially near cardiac end; vessels injected. Intestines markedly congested; no hæmorrhagic spots. Spleen normal. Kidneys about twice normal size, icteric, especially near hylus. Adrenals enlarged and apparently degenerated. Urine contained casts and a considerable amount of albumin. Leptospiras were found in suspensions of the liver and kidney in small numbers, none in the heart blood, notwithstanding thorough examination. Cultures of heart blood, however, yielded a growth of the organism.

Guinea-pig 63, inoculated February 11, 1921, with 0·5 c.c. culture. February 15, temperature 104·2° F.; February 17, temperature 106° F. No further symptoms. February 27, found dead. Autopsy showed enlarged dark-coloured spleen, also enlargement of liver and kidneys, and hæmorrhages in in the lungs. This animal undoubtedly recovered from a mild attack of yellow fever and succumbed to paratyphoid.

Guinea-pig 64, duplicate of the foregoing experiment. Temperature 104·6° F. on the afternoon of February 16, 104° F. on February 17. Icterus + + + +. Killed February 18 for examination.

Autopsy.—Skin and subcutaneous tissues canary yellow. Lungs peppered with characteristic hæmorrhagic foci. Stomach contained degenerated blood; four hæmorrhagic areas on dorsal wall. Vessels of intestines injected; some small pin-point hæmorrhages in mucosa. Liver much enlarged, friable, reddish brown in colour. Spleen normal (perhaps slightly enlarged). Kidneys much enlarged, degenerated, and icteric. Adrenals enlarged and congested. Bladder empty. Leptospiras found in fairly large numbers in heart blood and suspensions of liver and kidneys. Cultures of heart blood yielded a growth of the organisms. The typical infection in this animal was complicated by a mild paratyphoid infection.

The strain of *L. icteroides* was carried through thirteen passages in guinea-pigs, cultures being obtained again at the seventh generation. In later passages bleeding at the nose and anus became very common. At the completion of the experiments in Vera Cruz the cultures were turned over to the Rockefeller Institute for Medical Research, New York, where the organism was identified by immunological tests as belonging to the group of *L. icteroides* and distinct from *L. icterohæmorrhagiæ*. It has been maintained up to the present time and is still virulent for guinea-pigs.

Of the other cases studied (Cases 3, 4, 5, 8, 9), Case 3 was in the fifth day when discovered and Case 9 was indefinite and probably not yellow fever. Cases 5 and 8 were in the third day and Case 4 in the second day of the disease. The first two represent unfavourable cases for transmission purposes, while the last three mentioned may be considered as favourable. Transmission was attempted with all cases. With Case 9 there was no evidence of reaction. In the other cases, some of the animals innoculated showed the hæmorrhagic spots in the lungs, so characteristic of the leptospira infection, although no symptoms of infection had been detected during life. Control guinea-pigs, injected with normal human blood or with normal guinea-pig blood, fail to show these lesions.

That the transmission of yellow fever to animals and the isolation of *L. icteroides* is by no means easy is evident from the experiments which have been described. Only one animal of each of the first three generations acquired an infection which could be passed to other animals. The slight degree of pathogenicity of the human strain of *L. icteroides*, and the great variation in the susceptibility of individual guinea-pigs to infection with the organism, make it necessary to use a number of suitable (young) animals for inoculation with a given material. Moreover, the leptospira is by no means constantly demonstrable in the blood and organs, even in severe infection, either by dark field examination or culture, and it will not grow in the presence of bacteria or molds. Much difficulty was encountered in the present study, owing to the heat and humidity of the climate, in keeping the culture medium free from molds, and the most elaborate precautions had to be taken to avoid contamination from this source. Secondary bacterial infection (paratyphoid) in the guinea-pigs also proved troublesome, though as the strain became more virulent the incidence of secondary infections decreased.

II.—Serum Treatment of Yellow Fever.

During the course of the isolation experiments, I had the opportunity to observe a number of cases of yellow fever which were treated with the anti-*icteroides* immune serum prepared at the Rockefeller Institute for Medical Research, by Dr. Noguchi [5], and through the co-operation of Dr. Mauro Loyo, of the Beneficencia Español, I have been able to obtain the clinical notes.

With one exception (Case 1), in which the use of the serum was delayed until late in the third day of the disease, all the patients treated recovered. The charts and histories of the cases fail to convey an adequate idea of the action of the serum, because the improvement in the patient's morale or mental condition cannot be expressed in terms of temperature, pulse, or albumin. Unless the patient is actually seen, the status of the case may be misunderstood. In Case 2 this is well illustrated. At the time of the black vomit, and when albumin was present in such amounts that it had to be shaken out of the tube, the chart and laboratory findings made this appear a hopeless case. Nevertheless, as I have noted in the history, the patient's subjective condition was excellent.

In Case 2 it will be noted that there is almost a mathematical drop in the temperature with each dose of serum, and in practically every case the pulse began its downward trend with the beginning of treatment. Every time a patient was treated with serum, he was watched closely, and the pulse and temperature taken every half hour. With the exception of some uneasiness, and in one instance a rash, there was no unusual symptom following the treatment. The pulse and temperature dropped along the same lines and with the same degree during these half-hour intervals. It might be said that the use

of serum removes the discrepancy between temperature and pulse (Faget's sign). At all events, there is parallelism of temperature and pulse when serum was used, and a wide divergence otherwise, as shown before serum was given in Cases 4 and 6.

Seven cases in all are recorded. Cases 1 and 2 of the serum series are the same as Cases 1 and 2 of the transmission series, and the histories have already been given in the first part of this paper. Cases 3 and 4 of the serum series are the same as Cases 4 and 5 of the transmission series, and Case 7 of the serum series corresponds to Case 8 of the transmission series.

The total number of cases reported during the Vera Cruz epidemic was 204. One death occurred among the seven treated cases, and eighty-five deaths among the 197 untreated, that is, the mortality among treated cases was 14 per cent., as compared with 43 per cent. among untreated.

Since this difference is of prime importance in deciding on the efficacy of the treatment, it was believed profitable to examine it from a statistical standpoint so as to obtain a quantitative measure of its reliability. Accordingly the mean number of expected deaths based on the experience among untreated cases, and the standard deviation of the sample, were computed. The formulæ used were as follows [7]:

$$\text{Mean} = m\,\bar{p} + \frac{m}{n+2}\,(\bar{q} - \bar{p})$$

$$\text{Standard deviation} = \left\{ m \left(\bar{p} + \frac{\bar{q} - p}{n+2} \right) \left(\bar{q} - \frac{\bar{q} - \bar{p}}{n+2} \right) \left(1 + \frac{m-1}{n+3} \right) \right\}^{\frac{1}{2}}$$

Where in this case $n = 197$
$p = 85$
$q = 112$
$\bar{p} = 0.43$
$\bar{q} = 0{\cdot}57$
$m = 7$

Solving the equation for the mean, the mean number of expected deaths, had no treatment been used, is found to be 3·015. The actual number of deaths in the treated group was 1·0. The difference between the expected and the actual number is found to be 2·015.

Solving for the standard deviation it is found to be 1·33. Now the difference divided by the standard deviation ($\frac{2{\cdot}015}{1{\cdot}33}$) is 1·515. From a table of the area of the normal curve it is found that the area from the middle of the curve out to 1·515 is 0·435. Therefore the probability of a difference as great or greater than the one observed is (0·5 − 0·435) or 0·065. From this it is seen that if, out of 197 untreated cases, eighty-five die; then samples of seven drawn from untreated cases would have one or fewer deaths in each sixty-five samples out of a total of 1,000. Thus there is small chance that the treatment had no effect and that the seven treated cases were merely a random sample from untreated cases. Quantitatively, there are 935 chances out of 1,000 that the treatment was effective.

Case 3 (Chart III).—M. G., age 19, resident of Vera Cruz for three years. Taken sick shortly after dinner on December 20, 1920; headache and pain in the back and limbs. Admitted to the hospital on December 21 at 2 p.m. Face flushed, conjunctivæ slightly injected. Temperature 102·6° F. December 22 the temperature had fallen somewhat, and the patient's condition was apparently improved. In the afternoon, however, the temperature rose suddenly to 103·5° F., and tenderness developed in the epigastrium. Serum was given immediately (20 c.c.). The effect on the pulse, temperature, and general condition was evident within three hours. By the morning of the 23rd the patient's condition had improved to such an extent that it was decided no more serum was necessary. The tenderness of the epigastrium was considerably relieved, the patient was quiet, cheerful, and alert. His condition steadily improved, and he was discharged January 10, 1921.

Upon admission to the hospital the nitric acid test had shown no evidence of albumin in the urine; albuminuria appeared the following day, however, and increased to a considerable amount on the fifth day. At no time was the amount of urine less than 400 c.c. for twenty-four hours. There was no vomiting or bleeding from the gums or nose at any time.

The delay in the use of the serum was an attempt at control, to determine whether the case was a sufficiently mild one to improve without serum treatment. The developments of the 22nd suggested that the case was becoming a grave one, an opinion held by three physicians who had watched it from the beginning.

Case 4 (Chart III).—C. G., age 19, had resided in Vera Cruz for seven months. Onset evening of January 2, 1921, with headache and pain in the back and limbs. Admitted to the hospital on the afternoon of January 4. Face flushed, puffed, eyes bloodshot; patient restless but alert. 20 c.c. of serum was given immediately. Marked improvement was evident in pulse, temperature, and general condition. The following morning the patient's condition was such that it was decided no more serum was necessary. He improved rapidly, and was discharged January 13.

Albuminuria appeared on the third day in the hospital and persisted in traces until the seventh. There was no tenderness in the epigastrium, vomiting, nor bleeding from gums or nose at any time.

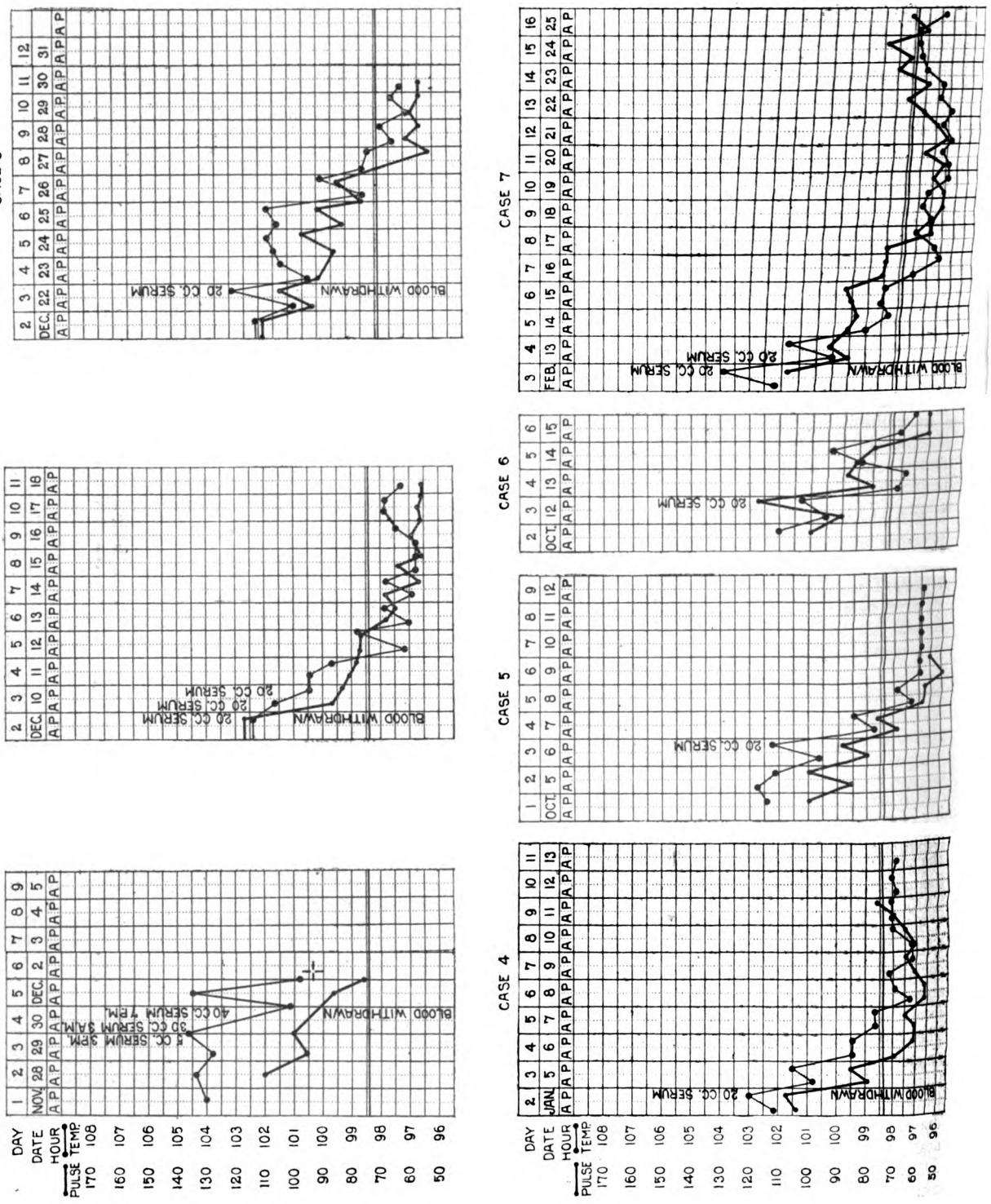
Case 5 (Chart III).—T. R. T., age 17 years. Duration of residence in Vera Cruz unknown. Onset in the morning, October 4, 1920; admitted to hospital afternoon of same day. Even at this early period the diagnosis was undoubted. October 5, condition the same. October 6, pains severe, patient restless and excited, temperature 102·3° F., conjunctivæ injected. The administration of 20 c.c. of serum was followed by a favourable effect on pulse and temperature. Improvement continued steadily after this time, and the patient was discharged on October 15.

A trace of albumin appeared in the urine on the fifth day in the hospital, but had disappeared by the next day. There was no vomiting at any time.

Case 6 (Chart III.)—A. L. Z., age 25 years, had resided in Vera Cruz for twelve years. Onset, October 10, 1920,

CHART III.

CASES TREATED WITH ANTI-ICTEROIDES SERUM



with chill, followed by fever. Admitted to hospital October 11 at noon, complaining of severe pains in head and back. On October 12 the diagnosis was clear, and the patient was given an injection of 20 c.c. of serum. There followed what is described as a violent reaction. The patient tossed about on the bed, and a reddish violet rash developed on the neck, especially near the back The attending physician administered a dose of caffeine and ordered a cold bath. Notwithstanding this heroic treatment, the temperature and pulse showed marked improvement, and from this time on the patient recovered rapidly. He was discharged on October 19.

The urine showed a trace of albumin on the fourth day in the hospital, but it had disappeared on the next day. There was no vomiting.

Case 7 (Chart III).—G. M. M., age 16 years, had resided in Vera Cruz one and a half years. Onset, February 10, 1921, with chill, followed by fever and pains in back and head. Admitted to hospital on the morning of February 12, in the third day of disease. Face flushed, conjunctivæ injected, urine showed a small amount of albumin. In the afternoon the patient was worse and had periods of faintness. The pulse condition was so poor that the attending physician thought best not to give serum immediately. By 4 p.m. the patient had rallied somewhat, and an injection of 20 c.c. serum was given. Temperature and pulse showed marked improvement. Another dose of 20 c.c. was given the following morning. The temperature rose that afternoon, but the next day it fell to normal, the general condition was much improved, and the patient made an uneventful recovery. He was discharged in thirteen days. The amount of albumin had reached an appreciable amount on the third day in the hospital, but it had disappeared completely by the ninth day. The quantity of urine reached the low mark of 100 c.c. for twenty-four hours on the third day; two days later it was 700 c.c. There was much soreness in the epigastrium, but no black vomit.

In addition to these cases observed in detail, it may be of interest to record the experience of the port quarantine officer at Gutiérrez Zamora. Because water transportation was possible, anti-icteroides serum was available at the port. Eighteen cases were treated with the serum during the first four-day period of the disease and from this group one death resulted and this was a patient treated at the end of the fourth day. In contrast to this there were three cases found in early stages of the disease (first three days) that did not receive the serum. Two received no treatment and the third was given 45 centigrammes of neosalvarsan (French) with no effect. All of these three cases terminated fatally.

III.—Vaccination against Yellow Fever.

The epidemic in Vera Cruz began on June 8, 1920' in the central part of the town. The second case occurred in the next house, the third across the street, and succeeding cases in the same block, the epidemic radiating from this block as a centre until the whole town was involved. The measures adopted were immediate screening of the patients by means of a metallic screen booth, fumigation of the infected houses with cyanide, and anti-mosquito work, including inspection, covering of tanks, and emptying or oiling of containers.

As one of the protective measures, vaccination [5] [6] of all non-immunes who desired it was begun at once. In all, 748 persons applied for vaccination, of whom 514 reported for the second injection. No reason can be given for the fact that 234 persons failed to appear for the second injection. None of the persons vaccinated had any history of having had yellow fever or having been present during an epidemic anywhere.

The total number of cases occurring during the epidemic was 204, of whom 86 died. Among the 748 persons vaccinated, three contracted yellow fever from one to four days after vaccination. Since this period is too short for the development of any appreciable immunity, these three cases may be regarded as controls, that is, they show that the vaccinated were exposed to yellow fever. Two other vaccinated persons contracted a disease which may or may not have been yellow fever. Both were extremely mild, recovery being complete in four days, and no examination seems to have been made for malaria. If we accept these two cases, which developed one month after vaccination, as yellow fever, then the incidence of yellow fever among the vaccinated was two, while among the unvaccinated there were 199 cases.

As to what percentage of unvaccinated non-immunes these 199 cases represent, it is difficult to say. The total foreign population of V era Cruz could not have been large, and it is not unl kely that the 748 vaccinated represented the larger portion of them. The population of Vera Cruz (which is estimated at about 65,000) is fairly permanent. Most of the non-immunes are Spaniards, who have taken work in Vera Cruz until they definitely decide where to settle. There is never any large importation of non-immune labour such as occurs in a sugar or a banana state. The largest group of non-immunes ever arriving is the military force, but in this case those known to be non-immune (i.e., coming from mountainous districts) are never intentionally sent to Vera Cruz ; usually transfers of troops are made from one coast town to another.

On the other hand, a certain number of young natives must have been non-immune, since there had been no cases of yellow fever in Vera Cruz since 1909 and no considerable epidemic since 1904. The belief was common that anyone who is born in Vera Cruz, or has lived there any considerable time, is immune, and it was not until the last part of the epidemic, after two native Veracruzanas and two young children had died of yellow fever, that the natives of the city began to apply for vaccination.

Although there is no way to estimate the unvaccinated non-immune population, it cannot have been more than a few thousand at most. Hence an incidence of less than three per 1,000 among vaccinated (two among 748), as compared with twenty to forty per 1,000 (assuming that there were 5,748 to 10,748 non-immunes) among unvaccinated, is an indication that most vaccinated persons escape infection.

We may record here an incident which was of considerable interest, though perhaps of little scientific importance. In a sectarian school, which was practically a non-immune community, since most of the teachers were Americans, and the pupils came from more or less distant mountain regions, four cases of

yellow fever occurred. One of the four, an American teacher, died, and immediately afterwards the whole community—about 154 persons—was vaccinated. No further cases of yellow fever developed.

SUMMARY.

Seven cases of yellow fever were studied during the epidemic in Vera Cruz in the fall of 1920. Transmission of the disease to guinea-pigs was accomplished in one of the seven cases, and from the animals of the third generation a strain of *Leptospira icteroides* was isolated in pure culture.

The strain induced in guinea-pigs all the typical symptoms of experimental yellow fever in this animal: fever, intense jaundice and nephritis, hæmorrhages into the gastrointestinal tract, and degeneration and necrosis of liver and kidney.

Of seven cases of yellow fever treated with the anti-*icteroides* immune serum, all recovered except one, in which treatment was delayed until the latter part of the third day of illness; that is, the mortality among treated cases was 14 per cent. (one in seven cases) as against 43 per cent. (eighty-five in 197 cases) among untreated. The favourable effect of the treatment was evident within a few hours by the fall in temperature and pulse-rate and by the improved subjective condition of the patient.

Among 748 non-immune persons vaccinated with the killed cultures of *L. icteroides*, two cases suspicious of mild yellow fever occurred after the lapse of one month, while among unvaccinated non-immunes 199 cases of yellow fever occurred. While the number of non-immunes present in Vera Cruz is not accurately known, it could not have been large, because of the small foreign population of Vera Cruz and the comparatively recent occurrence of epidemic yellow fever, hence it is believed that the vaccination considerably reduced the incidence of the disease.

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Intradermal Salt Solution Test in Scarlet Fever and Diphtheria Patients (W. J. Baker, *Jour. Amer. Med. Assoc.*, Nov. 15, 1924).—From the study of seventy patients with scarlet fever and thirty patients with diphtheria, two-thirds of whom were children, it appears that in these diseases the disappearance time of intradermally injected salt solution is reduced. The reduction parallels the severity of the intoxication. This test aids in indicating how the patient is getting along and in predicting the outlook for the near future.

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MAY 1, 1925.

A WHITE AUSTRALIA: IS IT A POSSIBILITY?

By SYDNEY J. SKERTCHLEY, J.P.

(*Continued from page* 168.)

CHAPTER XII.

Urban Australia.

The cry of "back to the land" has been ringing in English ears for years. It is felt by many, sus-

pected by most, and known by experts that not only does city life tend to impair physique, but it so affects the vital powers that sterility, not comparative, but absolute, is the penalty exacted by nature for the indulgences the town offers. France has been compelled to echo the same cry. M. A. de Quatrefages, the eminent anthropologist already quoted more than once, wrote as follows, so long ago as 1886:

"The very progress of civilization sometimes results in the vitiation of certain conditions of life. Such is the almost inevitable result of the crowding together of human beings in a relatively limited space. This is one of the points most clearly demonstrated in the statistical researches of M. Boudin upon the comparative mortality of the country and of barracks for example. A comparison of our large towns and rural districts leads to the same result, and points to a special action upon the organs of reproduction. M. Boudin could not find a pure-blooded Parisian whose genealogy could be traced for more than three generations. At Besançon, town families become extinct in less than a century, and are replaced by others from the country. London, I have been assured, presents a similar phenomenon."

Let us see what London proves. In 1885, my friend Dr. J. Cantlie, above cited, delivered before the Parkes Museum of Hygiene a lecture on "Degeneration among Londoners," which roused much attention. He says, "Some four years ago, when my attention was first drawn to this subject, I started with the premises that a Londoner was one whose grandparents and not the parents only, came under the category; but I had to stop, as I could find no such specimens." The nearest approach he could get were of generations whose grandfather or grandmother came from the country. This interesting brochure gives much detail, which, though important, we must pass over in silence. Among other matters, he shows that London is not governed by Londoners: "Of the last thirty Lord Mayors mentioned (in Orridge's account of the Lord Mayors of London) twenty-seven were born in the country, and the remaining three of country parents." I will take it, then, that no one who has paid attention to the subject doubts the appalling effect of town life. Let us now see how this new land of ours, this splendid country that has only 1·46 European inhabitants to the square mile, distributes its population.

Mr. Knibbs writes: "A feature of the distribution of population in Australia is the tendency to accumulate in the capital cities. To such an extent is this metropolitan aggregation carried, that in every State the population of the capital far outnumbers that of any other town therein, and ranges between nineteen and forty-six per cent. of the entire population of the State." The actual percentages on the total of the State are: Melbourne, 43·11; Brisbane, 25·04; Adelaide, 45·41; Perth, 19·26; Hobart, 21·92; Commonwealth (six cities), 36·21. This is over five times the proportion obtaining in Prussia, and between twice and three times that of England. Now this is a very important, and for us an unfortunate fact, and we must give a few more details, to bring home the magnitude of the misfortune.

The total population of the Commonwealth in 1907 is given officially as 4,197,037. There are sixteen towns having populations of over 20,000, if we include Rockhampton, which fell just below that figure. They are:

Sydney	577,180
Melbourne	538,000
Adelaide	178,000
Brisbane	135,655
Newcastle	63,250
Perth	50,380
Ballarat	48,607
Bendigo	44,458
Hobart	40,326
Broken Hill	31,000
Kalgoorlie and Boulder	29,242
Geelong	28,021
Launceston	24,536
Fremantle	21,000
Charters Towers	20,976
Rockhampton	19,691
Total ...	1,850,622

This, in round numbers, means that nearly one-half of our population is concentrated in sixteen centres.

This is a very serious condition of things. I have not at hand particulars enabling me to compare European countries in this connection, but I have little hesitation in saying that it is unparalleled. Other countries, again, have many populous centres, whereas each of our States has but one, and this the capital. How different this is from the home land is illustrated by the fact, seldom realized, that a radius of twenty miles round Manchester embraces a larger population than a similar circle struck from London's centre. It means more even than mere numbers indicate. It shows that the mass of our immigrants linger about the capitals at which they disembark, and, moreover, that even our natives tend to flock to the towns, not only not making good the deficit due to impaired vitality but swelling the already too rapid growth of the cities as compared with the settlement of the soil. City life in Australia is no exception to city life elsewhere; it means rapid decay of reproductive power; it spells not merely arrest, but retrogression. Our urban population is disastrously disproportionate to our area.

As I pointed out in my first chapter, this inquiry does not deal with causes, but with effects. The causes which lead to decrease of population are many, and vary from time to time; and from place to place; and to discuss them would be to darken counsel with words. What we have in hand is a review of the facts, a simple statement of the nature and results of immigration. Climate, disease, changed habits due to new conditions reacting upon the organism, and many other direct or in-

direct causes, we have seen, have invariably brought about the same result—the lessening of the fertility and ultimate extinction of the newcomer. Nevertheless, we may here pause to ask whether, in view of the vital importance of the question to ourselves, we can trace any determining cause for the steady decline of the birth-rate of Australia.

I am inclined to attribute a large share of this melancholy condition to the abnormal aggregation of our population in cities. It is difficult to prove this, and will be until special means are adopted by our statisticians to determine the relative rates of natural increase in the urban and country areas. These gentlemen now work on a common basis, so that their results are comparable, and their onerous duties are carried out so efficiently as to claim the admiration of all who have to consult them technically. I trust that, now that the importance of this matter is demonstrated, this distinction may be made an object of their research. How great the difference between the two conditions may be roughly gathered from the following table, by Sir J. A. Baines, in the *Journal of the Royal Statistical Society*, 1903. I take it from Dr. Gregory's new work on Australasia, before quoted, and may remark that the learned writer is a strong advocate

	Densely peopled			Sparsely peopled		
	Percentage on total		Density	Percentage on total		Density
	Area	Population		Area	Population	
Victoria	20·43	73·51	48·94	34·16	3·51	1·39
S. Australia	1·34	79·71	23·79	2·51	1·67	0·27
Queensland	1·49	44·26	22·28	53·94	4·85	0·07
New Zealand	31·60	46·31	10·92	68·40	53·69	5·85

of the White Australia aspiration, and so is a hostile witness.

The constrast is a remarkable one, and worthy of serious study.

Yet there are some few details that tend to show, what I have no doubt is the fact, that the urban birth-rate is lower than the country birth-rate. For example, Mr. Thornhill Weedon, in his last official Queensland report (1908 for 1907), says: " The ratio of birth increase was 3·73 for the whole State, but was twice as great outside as within the metropolitan area. Great variations were apparent between the two years (1906-7) in the number of registrations in the different district groups. Thus, in the Moreton district, where there were 2,008 births in 1906, there was a decrease of thirteen in the following year; whilst on the Downs, with approximately a similar number in the previous year, there was in 1907 an increase of 253 numerical, or thirteen per cent. proportional." The first statement directly confirms my suggestion: and the second, though not quite so strong, supports it, for Moreton district is the metropolitan area, and includes Brisbane, and the Downs is rural; but as it includes Toowoomba, the largest inland city in the State, with a population of 14,087, it is not as typical as could be desired.

Here let one pause to point out a grave error, often committed even by scientific writers. They fail to see that though the healthiness of a district lowers the death-rate, it has no necessary effect upon the birth-rate. Australia, as we have seen, has a low birth-rate combined with a low death-rate. This combination increases the natural rate of increase. Yet, in spite of this, the net rate of increase, as we have shown, has steadily fallen. Australia is healthy enough; its people live longer than the average, but, in spite of this, the birth-rate has decreased. Yet writers confuse these factors.

For example, Dr. Gregory, in his "Australia," vigorously maintains the permanent habitability of the tropics by Europeans. He quotes with approval from a paper by Mr. Sambon in the *British Medical Journal* (1897) the opinion: " First, that European emigrants can live and perpetuate their kind in tropical regions; secondly, that the difficulties in the way of colonization are not due to climate, but to parasitism; thirdly, that acclimatization is, to a great exent, a mere question of hygiene." Having accepted this fiction as if it were fact, Dr. Gregory proceeds to clinch his argument with real facts, pointing out case after case of tropic or hot unhealthy lands—India, the West Indies, Algeria, &c.—which have been rendered more salubrious by modern scientific skill. Algeria delights him, and in triumph he quotes old General Duvivier's saying that (I translate) " cemeteries are the only colonies always flourishing in Algeria," only to point to the moral that " Algeria is now one of the best and most popular of sanatoria for European invalids." So it is: but Europeans only get well there, they do not get born there, which is the matter at issue.

So far from such facts as the above proving the case they are cited in support of they tell quite the other way. There is no doubt whatever that improved hygiene, including sanitation, the treatment and sometimes the abolition of diseases, the more rational way of living, &c., have in the last half century added a cubit to the span of life. Yellow fever in Cuba, malarial fever in Panama, are no longer the terrors they used to be; they are under even stricter control than small-pox in England. But the net result of this splendid work has been to reduce the death-rate, not to increase the birth-rate.

Annotations.

Observations on North China Intestinal Parasites of Man, Ernest Carroll Faust, *Amer. Jour. Trop. Med.*, July, 1924).—An intensive study of third-class patients on the medical service of the Peking Union Medical College Hospital was undertaken to determine the importance of parasitic infection in clinical diagnosis in North China. Sixty cases were studied. Each case was under a careful scrutiny for a period of ten days or more, during which time every stool passed by the patient was examined. In all 1,409 stools were studied, or an average of 23·48 per patient. Controlled methods of preparation of the stool for examination indicated that concentration methods were valuable only where a single specimen of stool was available for study. In cases where large numbers of stools of the same patient were examined concentration methods added only ten per cent. to the findings. Forty per cent. of the infections were diagnosed after the first day, thirty-five per cent. of which were diagnosed first from unconcentrated preparations. Eighty per cent. of the cases studied harboured intestinal entozoa. While this infective incidence is comparable to that of a sick population in Central China, it is less intensive than the latter. The respective indices for the two areas are as follows: Central China (Wuchang survey), protozoa, 228·7; helminths, 234·3; North China (present study), protozoa, 101·6; helminths, 88·03. The clinical significance of the study is demonstrated by the fact that 53·3 per cent. of the series harboured clinically important parasite infections. Twenty per cent. of the cases had a major diagnosis due to parasites; 46·6 per cent. had a minor diagnosis of parasites; 13·3 per cent. of the cases had both major and minor diagnoses occasioned by infections of the digestive tract due to parasites. No proof can be advanced from the present study regarding flagellate entozoa in amœbic dysentery that there is a necessary relationship between the two infections. In the cases studied at least 89 per cent. of the patients secured their infections in the North China nosogeographic area. They belong to the lower middle-class and the poor class, which groups, on account of undernourishment, are likely to be more troubled with clinically important infections than are the upper classes. The Chinese, as a people, are not less susceptible to parasitic infection than other peoples, although light infections among Chinese are less likely to be clinically significant than in Occidentals living in China. Improper disposal of night-soil is responsible for all the helminthic infections in the intestinal tract of man in North China as determined by this study.

Herpetomonad Flagellates in the Latex of Milkweed in Maryland (F. O. Holmes, *Phytopathology*, Vol. XIV, No. 3, March 1924).—A flagellate infection of milkweed (probably *Asclepias syriaca* L.) was discovered during the autumn of 1923 near Baltimore, Maryland. The flagellates correspond fairly closely to those properly known as *Herpetomonas elmassiani* (Migone), described in 1916 by Migone in Paraguay. So far as is known this is the first report of such organisms in the United States. A red and black hemipterous insect, *Oncopeltus fasciatus* (Dall) is suspected of carrying the flagellates from plant to plant.

Case Resembling Endemic Typhus Fever (Brill's Disease) (*Med. and Scientific Arch. Adelaide Hospital*, No. 3, *Annual Report*, 1923).—G. C. female, 20, waitress, living at Hindmarsh, was admitted to hospital September 25, 1923, complaining of severe headache, abdominal pain and vomiting. Illness had begun September 22, with sudden pain in the lower part of the left chest, which had been increased by deep breathing, but had not been accompanied by cough. She had been drowsy since the onset of her illness, and had had diarrhœa during the first two days. She had had no epistaxis. Spleen slightly enlarged. Tender on palpation on the right hypochondrium. No rash was present. On September 26, agglutination reactions against the *B. typhosus* and *B. paratyphosus* A and B were negative. On September 29 a rash consisting of pink coloured macules and papules appeared on her arms, hands, thighs, feet and trunk. These disappeared on pressure, and varied in size from a pin's head to a third of an inch in diameter. She had also complained of severe aching pain all over her body. Rash had quite faded by October 4. Temperature, which had been 104°F. on admission, fell slightly but persistently until October 7, when it was normal, and continued so, coincident with her relief from symptoms. She was discharged well on October 17. On October 16 the Weil-Felix reaction was positive up to a dilution of 1 in 2,560.

A Microscopic Study of Mercury Absorption from the Skin (K. G. Zwick, *Jour. Amer. Med. Assoc.*, December 6, 1924).—Microscopic examination of intact animal skin, to which mercury in the form of mercurial ointment had been applied by unction, established: (1) The presence of globules of mercury (*a*) in the infundibula of the pilosebaceous follicles; (*b*) in the orifices and excretory ducts of the sebaceous glands. (2) The absence of globules of mercury (*a*) in the intact epidermal layers that are not constituents of the integumentary appendages; (*b*) in the cutis vera. Microscopic findings lead one to conclude that percutaneous absorption of mercury following inunction of animals with mercurial ointment takes place preponderatingly from the material deposited in the pores, consisting of the orifices of the hair follicles and of the excretory ducts of the sebaceous glands. Percutaneous absorption of mercury is not materially influenced by removing from the intact skin the excess of mercurial ointment deposited on it during inunction, because mercury does not penetrate into or through the intact epidermis.

The Effect of Carbon-Tetrachloride on the Egg-Laying Powers of the Female Hookworm (W.C. Sweet, *Amer. Jour. Hygiene*, November, 1924).—In most instances carbon-tetrachloride in doses up to 2 c.c. had very little inhibiting action on the egg-laying power of the female ankylostome. All inhibition had disappeared by the seventh day. Re-examinations in either field or laboratory work could be made one week after treatment. In this series of egg counts the number of eggs per gramme of fæces from the same persons was found to vary with the character of the stool. The ratio established was very close to that found by Stoll working on necators in Porto Rico. The theoretical number of worms responsible for the eggs counted was found to be high and, on theoretical grounds, it was predicted that female ankylostomes would be found to have about five times the egg-laying powers of female necators.

Treatment of Hookworm Disease with a Combination of Carbon-Tetrachloride and Oil of Chenopodium. Comparison of Results of Simultaneous and Delayed Administration of Magnesium Sulphate (F. L. Soper, *Amer. Jour. Hygiene*, November, 1924).—Hookworm infestation in Paraguay is very heavy. Fortunately, the infestation is over ninety per cent. of the less resistant and probably less harmful necator. The combination of carbon-tetrachloride, three parts, with oil of chenopodium, one part, in adult dose of 2·4 c.c. (1·8 c.c. of the former and 6 c.c. of the latter) is very effective in an area of low ankylostome infestation. No toxic symptoms were reported. Like other anthelmintics, this combination gives a higher percentage of total worms removed in heavily infected cases than in those with few worms. This is probably due to a larger percentage of immature forms in heavily infested cases. The simultaneous administration of magnesium sulphate tends to delay the expulsion of many worms until the second day. There appears to be, however, no diminution or delay of anthelmintic action. A simultaneous reduction of toxicity and cost per person treated may be expected from the introduction of this method of administration in field work against hookworm disease.

Abstract.

THE ABSENCE OF ENDEMIC GOITRE IN HONOLULU.[1]

By J. Christopher O'Day, M.D., F.A.C.S.

THE goitre problem of the Pacific Coast, particularly of its north-west portion, is still unsolved. Towards such a solution there has been no little endeavour, yet up to the present time no reward has been claimed. As a result of my own investigation the conclusion was reached that endemic or retentive goitre had to do with the character of the drinking water. The conclusion, however, was based entirely on personal and the general observation of others. The problem in no way is able to lend itself to actual scientific research, and this in face of the fact of our work being carried on in a district where endemic goitre enjoys an incidence of close on to 50 per cent., namely, Portland, Oregon. With the co-operation and guidance of no less able clinicians than Lawrence W. Snelling and Franklin C. Maclean, interest in the ætiology of retentive goitre gave way to that of those hypersecretive types that were accompanied by a diabetic syndrome. When further work and observation showed that this diabetic syndrome would entirely clear after lobectomy, we set about to discover, if possible, just what it was in these odd cases of Graves's disease that was directly responsible for the loss of the carbohydrate tolerance.

First, was there a lesion of the sympathetic system which caused the hypersecretion of the thyroid? If so, was the same lesion capable of disturbing the secretion of the islands of Langerhans and thereby precipitating the diabetic syndrome? Again, could the hyperthyroidism produce the extreme thirst, polyuria and the ravenous appetite and the glycosuria be but a mere metabolite? But when it was continuously and invariably observed that the metabolic rate was always in proportion to the degree of hyperthyroidism, and that the basal metabolism was in no way related to the carbohydrate overthrow, our questions were forced to go unanswered.

In a subsequent article, Snelling emphasized the point by showing that the degree of hyperthyroidism bore no relation whatever to the precipitation of the diabetic syndrome.

It was during this time that Maclean was carrying on the research work, the result of which has been published.

The sugar content of the blood in diabetes of thyroid origin is as variant as that of the pancreatic lesion, and resolves itself into that last conjecture of a hypothetical sugar threshold. But the hyperglycæmia and increase of the metabolic rate, which are constant findings with hyperthyroidism, cannot be regarded as a step towards the development of the occasional cases wherein the sugar mobility assumes the rôle of the pancreatic lesion.

While this reference to hyperthyroid goitre is foreign to that which the title of this article more reasonably suggests, it is mentioned since it is now known that Lugol's solution is quite capable of restoring both the carbohydrate tolerance and a marked return toward the normal metabolic rate. But the improvement is not permanent and a second administration of the drug is disappointing.

Up to a certain point only is the iodine able to stay the storm—at that point help is needed. Whatever the help may be remains to be discovered. That the kidney function might be the factor has nothing beyond the notion to sustain it. The

[1] Abstracted from the *Medical Journal and Record*, February 4, 1923.

results of our observation and investigations have been published.

Endemic or retentive goitre has not been observed in Honolulu. It was this fact which led to our comparing the water supply of the island city with that of the goitre districts of the coast. Before making such comparison it may be of interest to mention, in brief, the presence of toxic goitre among the Oriental races of the islands.

It should be recalled that the percentage of toxic or hyperthyroid goitre is no greater within the endemic districts than it is, generally speaking, throughout the United States and Canada. This type of goitre is encountered in Honolulu, but just what incidence to population has not been learned. While it is among the Japanese that it seems to be the most prevalent, once comparison is drawn between the Japanese population, the predominant of the Orientals, it is immediately made to appear that toxic goitre here occurs in about the same proportion as that noted throughout the mainland and Canada.

In this reckoning the native Hawaiian cannot be included, for the type of individual that is prone to this affliction is but too seldom met among the phlegmatic people. It was Dr. Wayne Babcock, of Philadelphia, who first drew my attention to this, the consideration of types.

The first change necessary to start the development of endemic or retentive goitre is that which takes place in the character of the thyroid's secretion. Its consistency becomes viscid to a degree wherein it is no longer able to enter the stomata of the lymph radicles. Accumulation within the follicles results, and the gland is made to bulge proportionate to the degree of accumulation. We conjectured that some definite arrangement existed between the secreting follicles and lymph radicles, and which, if understood, would eliminate the speculative conclusions, of which there were two, namely, was the thickening of the thyroid secretion due to a faulty functioning of the follicles or was it the result of a scanty lymph supply into the follicles for the physiological thinning of their secretion? In other words, just how did the mineral free water exert its deleterious influence on the interdependence of thyroid and lymph commingling?

With this in mind, a number of normal thyroids were injected, several methods of injecting being used, but no one of the subsequent sections threw the least light on the mechanics of the interrelated function of blood supply to that of lymph and the gland's secretion. With a preponderance of evidence to support the belief that endemic goitre is caused by the character of the drinking water, it is interesting, at least, to find further proof on comparing the character of the drinking water of Honolulu with that of the districts where this disease is prevalent.

The artesian water with which the city of Honolulu is supplied is one of the finest drinking waters in the world. It is unique in its low content of sodium iodide, and which seems to be bound in a rather unstable way with an equally low content of the chloride of soda and potash. Calcium carbonate represents the highest per cent. of mineral content, yet insufficient to cause the water to be hard. Its bacterial count is nil. The artesian wells providing this water vary in depth from 500 to nearly 1,000 ft. An average of 20 ft. deducted from the depths of each well will replace the number of remaining feet below sea level.

The discrepancy in the depths of the wells is due to the elevations and depressions in the roof of the artesian basin and not to the surface location of the well. The almost continuous rainfall of the mountain tops has to percolate through thousands of feet of volcanic ash, rock, lava, and in many places substrata of ectopic coral before reaching the artesian basin. From this it may be readily understood how such altitudes would place the plus pressure on the side of the artesian basin and prevent the waters of the ocean from finding their way into the basin.

Current Literature.

THE INDIAN MEDICAL GAZETTE,
February, 1925.

Typhus-Like Fever, Probably Tick-Typhus, in Central India (J. W. D. Megaw, F. B. Shettle and D. N. Roy).—These cases are of interest as furnishing fresh evidence of the occurrence in India of a typhus-like fever which is identical with or closely related to the spotted fever of the Rocky Mountains. All the cases occurred among a body of more than two thousand men who were engaged in manœuvres in two camps, each situated about ten miles from Saugor, in Central India, and about twenty miles from each other. The disease is liable to attack persons leading an open-air life, and in this respect resembles Rocky Mountain fever and the typhus-like fever of the Kumaon Hills. The clinical characters also show a close resemblance. Lice are completely excluded as cause of the disease, and ticks are doubted for more than one reason, although it appears to be probable that the cases belong to the tick-typhus group.

Indian Tick-Typhus (J. W. D. Megaw).—The author asserts with some confidence that a tick-borne fever of the typhus group occurs in India, and the use of the term "tick-typhus of India" or "tick-typhus" will be most appropriate as a provisional designation for the disease. The term "spotted fever of India" has been suggested with a view to indicating the relationship to the known disease which it most closely resembles, but the word "spotted" has been used for so many diseases that it does not convey any precise idea, whereas the term "tick-typhus" will be applicable to the disease in any part of the world.

Notes on Carbon Tetrachloride as an Anthelmintic (A. C. Chandler and A. K. Mukerji).—An anthelmintic should be judged on the basis of (*i*) safety for the patient; (*ii*) effectiveness in expelling worms; (*iii*) simplicity of administration on a large scale; (*iv*) lack of unpleasantness in taking

or in after-effects; and (*v*) cheapness. No one anthelmintic can be expected to be effective for all kinds of worms. As regards safety to the patient, CCl_4 in a dose of from 3 to 5 c.c. can be regarded as being as safe as any effective anthelmintic, and distinctly safer than oil of chenopodium, providing certain precautions be taken. It can be given with confidence to kala-azar and malaria patients during remissions of fever, is well tolerated by young children, and is safe for pregnant women. It is distinctly superior to chenopodium in eliminating necators, whereas it is approximately on a par or a little inferior in removing ankylostomes. It is also much cheaper than chenopodium. CCl_4 has a distinct ascaricidal action, especially when combined with chenopodium. Alone it is a little less effective than either chenopodium or santonin. Given orally it seems to have a more decided action on oxyuris than any other anthelmintic tried. The drug has little or no action against trichuris, strongyloides or tapeworms.

Gaucher's Type of Splenomegaly in a Mahratta Village, with a Case Treated by Splenectomy (W. C. Spackman and F. P. Mackie).—It is stated by the inhabitants of Dhagur that a disease exists there which is always fatal after a number of years, beginning at an early age and attacking only Mahrattas. A considerable number of young males are carried off by it. The disease is known as *potedhagur* (big stomach). There is a low type of fever and progressive weakness. There is no kala-azar in the district.

THE INDIAN MEDICAL GAZETTE.

March, 1925.

Variations in the Potency of Digitalis Preparations in the Tropics (R. N. Chopra and S. C. Bose).—Clinical observations as well as biological and chemical assays of tincture of digitalis show that it undergoes deterioration rapidly in a tropical climate such as that of India. This deterioration cannot be accurately determined by any single method in the laboratory, such as Hatcher's "cat method"; the "frog method"; or Kundson and Dresbach's chemical method. Clinical tests give the most reliable information. The average dose of 15 c.c. of the tincture per 100 pounds of body weight required to get the patient under digitalis effect in 36 to 48 hours is considerably increased after the tincture has been in the tropics even for a short time. Deterioration is due to some change in the digitalis glucosides, the nature of which has not yet been determined. The tinctures on dilution become darkish in colour, unlike good tinctures, which are light green and uniformly opalescent. Such tinctures are more toxic to cats when given intravenously, but a considerable weakening in the therapeutic efficacy is evident. The dosage of tincture of digitalis generally employed by medical practitioners in India (i.e., 5 to 10 minims three times a day) is far too small to get the patient under the digitalis effect within a reasonable period (three to four days). With tinctures of standard strength doses of at least 20 to 30 minims three times a day should be given. If rapid effects are desired in urgent cases these may be increased from 45 to 60 minims until the amount calculated by Eggleston's method is given.

An Investigation into the Origin of Cholera Epidemics in the Jheria Coal-Fields (G. C. Maitra).—A cholera-like disease with indefinite etiology exists in the coal-fields. Further investigation will be made of this important condition when opportunity offers. This disease appears to be of low infectivity and was never seen to assume epidemic proportions nor to give rise to multiple cases in the same family. Cholera epidemics due to Koch's vibrio were imported last year into the coal-fields from the pilgrim centres of Puri and Baidyanath. Elaborate and costly disinfection measures are only justifiable when the outbreak is due to the genuine cholera vibrio, and as this can only be ascertained by careful bacteriological examination, a competent bacteriologist and epidemiologist with a mobile laboratory is a necessity for the coal-fields. In the absence of a competent bacteriologist all cases which have the clinical features of cholera must, of course, be dealt with as if they were true cholera. The value of specific immunization against cholera, both subcutaneously and by the mouth, cannot yet be assessed without further extensive trial side by side with other methods of preventive medication. The scientific method of prevention is not necessarily the best; the prejudices of the affected population and the local conditions must be taken into account.

The Treatment of Asthma (H. W. Acton and R. N. Chopra).—For treatment of asthma during the stage of attack, ether, chloroform, chloral hydrate and morphia are all useful, but they act without removing the cause, and are merely used as a *placebo* to relieve symptoms. In *sympathetic predominance* adrenalin fulfils all requirements. In *vagal predominance*, on the other hand, adrenalin, when injected intramuscularly, has only a slight and evanescent effect in overcoming the bronchial construction. The drugs preferred during acute attacks are the phenacetin group. The nitrites give great relief in the failing renal heart and in cardiac failure. The value of atropine and cocaine, when given as a fine spray, is very great, for both paralyse the vagus and lessen bronchial secretion.

The Migration of Hookworm Larvæ in Soil (A. C. Chandler).—These experiments confirm the conclusions reached by Augustine, Cort and Payne concerning (1) the practical non-existence of lateral migration of hookworm larvæ; (2) the easy scattering of larvæ by surface water; (3) the tendency to upward migration through coarse soil; and (4) the very restricted migration on the sides of a soil wall. The author's observations, however, point to a definite negative geotropism as the principal factor in guiding larvæ upward, rather than an upward flow of surface water, as suggested by Payne.

Original Communications.

YELLOW FEVER RESEARCH, 1918-1924: A SUMMARY.

By HIDEYO NOGUCHI, M.D., M.S., Ph.D., Sc.D.

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ISOLATION OF LEPTOSPIRA ICTEROIDES.

Leptospira icteroides was first isolated in Guayaquil, Ecuador, in 1918 [1], from six of twenty-seven selected cases of yellow fever diagnosed by Pareja and Elliott [2]. The same organism was isolated by Kligler and myself [3] in Mérida, Mexico, in 1919-1920, from blood taken from a yellow fever patient on two successive days, the second and third of his illness. Pérez Grovas [4] obtained a strain of *L. icteroides* in Vera Cruz in 1920 from one of two cases of yellow fever studied, and in the same year Kligler and I [5] isolated the organism from four of thirteen cases in northern Peru. Le Blanc [6] succeeded in isolating a strain from one of two early cases in Vera Cruz in 1921. The latest positive results (1923-24) have been obtained in Palmeiras, Bahia, Brazil, by Vianna and Bião, of the American-Brazilian Yellow Fever Commission, who isolated two strains from two of nine cases [7]. Negative results were obtained by Lebredo [8] in Mérida, Mexico, in the summer of 1919, and by Borges Vieira [9] in the suburbs of Bahia in 1920.

One of the Guayaquil patients died four days after the onset of illness, and the liver, which was removed a few hours post mortem, was found to contain a small number of leptospiras; guinea-pigs were inoculated with the suspension of the liver, and a strain of *L. icteroides* was obtained from the passage animals.

Of the sixteen positive blood specimens,[1] twelve were withdrawn between one and three days, two between three days and four days, and two a little later than four days after onset; hence the indications are that the organism is present in the peripheral circulation more frequently (88 per cent of cases) during the first three days of the disease.

The total number of strains of *L. icteroides* isolated is therefore fifteen.

The ætiological relation of *L. icteroides* to yellow fever can be shown also by Pfeiffer tests, with cultures of the organism, of the serum of cases already in the convalescent period. Perez Grovas [10] found the Pfeiffer reaction with *L. icteroides* constantly present in seventeen convalescents from yellow fever. The American-Brazilian Yellow Fever Commission [7] made Pfeiffer tests of the serum of fourteen cases of yellow fever in Brazil against *L. icteroides* from sources in Ecuador, Mexico, Peru, and Brazil, and obtained positive reactions in all. Parallel reactions with *L. icterohæmorrhagiæ* were negative, as were also Pfeiffer tests of normal sera. Pothier and Pareja [11], in Colombia, in 1923,

TABLE I.—ISOLATION OF LEPTOSPIRA ICTEROIDES.

	Day of illness when blood was withdrawn	Results of: Dark-field examination	Results of: Direct inoculation into guinea-pigs	Results of: Direct cultivation	Results of: Cultivation from passage guinea-pigs
Guayaquil (Noguchi)					
1. Case 1 (died)	4 days and a fraction		Blood +	+	+
2. ,, 2 (recovered)	3 ,, ,, ,,		Blood +		−
3. ,, 3 ,,	2 ,, ,, ,,		Blood +		+
4. ,, 4 (died)	2 ,, ,, ,,	Liver +	Blood + / Liver +		+ /
5. ,, 5 ,,	4 ,, ,, ,,		Blood +		+
6. ,, 6 ,,	3 ,, ,, ,,			+	+
Mérida (Noguchi and Kligler)					
7. Case 2 (recovered)	1 day and a fraction		Blood +	+	+
	2 days and a fraction		Blood +	+	+
Vera Cruz (Pérez Grovas)					
8. Case 2 (recovered)	1 day and a fraction		Blood +		+
Morropón (Noguchi and Kligler)					
9. Case 10 (recovered)	1 day and a fraction		Not practicable	+	+
10. ,, 11 ,,	2 days and a fraction		,,	+	+
11. ,, 12 (died)	2 ,, ,, ,,		,,	+	+
12. ,, 13 (recovered)	2 ,, ,, ,,		,,	+	+
Vera Cruz (Le Blanc)					
13. Case 2 (recovered)	1 day and a fraction		Blood + (confirmed on third passage)		+
Palmeiras (Vianna and Bião)					
14. Case 3 (recovered)	Less than 1 day		Not practicable	+	+
15. ,, 5 ,,	1 day and a fraction		,,	+	+

[1] One of the fifteen patients yielded positive results in the case of specimens drawn on two successive days.

obtained positive Pfeiffer reactions with *L. icteroides* and negative with *L. icterohæmorrhagiæ* in four persons recovering from a disease suspected of having been yellow fever, the clinical diagnosis being thus confirmed.[1]

Adaptation of Leptospira icteroides to Experimental Animals.

Young guinea-pigs, which are the only animals so far found to be useful in the transmission of yellow fever directly from human cases, are, however, rather refractory at best, while fully-grown guinea-pigs are so resistant that even adapted guinea-pig passage strains fail to infect them. Even in young guinea-pigs a clear-cut, typical infection, with hæmorrhages, jaundice, and nephritis after three to six days incubation, is not always induced by inoculation of blood from yellow fever patients, but a suggestive febrile reaction and capillary injection of the conjunctivæ, after a relatively long interval,[2] may be the only symptoms noticed. The period of incubation in the first generation in guinea-pigs has occasionally been as long as eight, nine, or even ten days, and only a few animals among many receiving the same blood may react to the inoculation. If the mild infection at first induced is allowed to run its course, the animals completely recover, but if the blood, or a suspension of liver and kidney, taken at the height of fever, is inoculated into several young guinea-pigs, the febrile reaction may occur sooner and the other symptoms of yellow fever become more distinct in some of the animals. A fatal infection is sometimes induced in the second generation, but it may be necessary to make further passages before the strain acquires sufficient virulence for the guinea-pig to induce typical fatal infection. Autopsy shows the characteristic petechial spots in the lungs, hæmorrhages into the gastro-intestinal tract, acute nephritis, and yellowish-brown liver.

In the early experiments in Guayaquil, the necessity of timely transfer from mildly infected to new animals was not realized, and the opportunity of obtaining a larger number of strains of the organisms was thus lost. Of the twenty-seven cases studied, there were five which furnished strains of moderate initial virulence, one which required three passages in the guinea-pig to induce a fatal infection, and nine others which induced an initial disease so mild that the opportunity for transfer was lost before the nature of the infection was realized. That these animals (sixteen in all), which showed only a slight febrile reaction and a trace of jaundice, actually passed through a mild infection with *L. icteroides* was subsequently proven by their immunity to massive doses of adapted strains of the organism or by the characteristic hæmorrhagic spots in the lungs revealed by examination after recovery. Injection of blood from patients suffering from diseases other than yellow fever does not confer immunity against *L. icteroides*, nor produce the petechial lung hæmorrhages, in guinea-pigs.

L. icteroides is essentially a human pathogen, but when fully adapted to the guinea-pig its virulence for this animal may reach such a titre that 0·00001 c.c. of a suspension of liver or kidney of an infected animal, or of culture, will induce a fatal infection, with characteristic hæmorrhages, jaundice and nephritis. The incubation period becomes fixed to three to six days, as in human yellow fever.[1]

Guinea-pig passage strains of *L. icteroides* are virulent also for young puppies, marmosets, and "prego" monkeys(*Cebus macrocephalus*), and when used in massive quantities, representing several thousand minimum lethal guinea-pig doses, induce symptoms and lesions more strikingly like those of human yellow fever: intense jaundice, anuria, albuminuria, and "black vomit." Guinea-pigs also invariably show effused dark-coloured blood in the stomach, and hæmorrhages into the intestines are common. Autopsy reveals fatty liver, congested kidneys, and normal spleen. The histopathological changes in experimental yellow fever have been studied in detail by Perrin [12] and Muller [13]. The reader is referred also to the recent work of W. H. Hoffmann in Havana [14]. All these investigators have concluded that the pathological changes induced in experimental animals by *L. icteroides* are identical with those of human yellow fever.

Muller [13] has studied also the hæmatological findings in experimental yellow fever and confirmed the earlier observations [15]. There is moderate leucopænia, comparatively slight reduction in hæmoglobin and red blood cells or none at all, as in human yellow fever [2], [16], [30].

One of the proverbial symptoms of yellow fever is the so-called Faget's sign, or relatively slow pulse with high temperature. Cohn and I [17] studied the effect of *L. icteroides* infection on guinea-pigs and marmosets by means of electrocardiographic records and found that the same phenomenon appeared in experimental animals. Relative brachycardia is observed also in human infectious jaundice, and in experimental infection with *L. icterohæmorrhagiæ*.

The Filterability of Leptospira icteroides.

Reed and Carroll [18], Rosenau, Parker, Francis, and Beyer [19], Marchoux, Salimbeni, and Simond [20], showed that the virus of yellow fever passes through the pores of Berkefeld filters. In the early experiments in Guayaquil [21], it was found possible to infect guinea-pigs with the filtrate obtained by passing dilute infective liver and kidney suspension

[1] Recently Muller and Blaisdell have obtained positive Pfeiffer reactions with the sera of persons who had yellow fever during the Salvador epidemic of 1924.

[2] It may be mentioned here that in Rocky Mountain spotted fever, the incubation period in guinea pigs is between three and six days, but in the case of a weakened guinea-pig passage virus it may be as long as sixteen days. Such a virus regains its usual virulence on subsequent transfers to guinea-pigs.

[1] That the incubation period in human yellow fever may be longer than six days was observed by the French Commission to Brazil (*Ann. de l'Inst. Pasteur*, 1903, xvii, 665), who described two instances of experimental, and three of natural infection, in which the incubation period was estimated at twelve to thirteen days.

through Berkefeld filters, and subsequent experiments (Nichols [22], Dieterich [23], the American-Brazilian Yellow Fever Commission [7]) have shown that *L. icteroides*, whether in infected organ suspensions or in culture, is capable of passing through Berkefeld filters of the V and N grades. It is of special interest that Nichols used in his filtration experiments the original filters employed by Walter Reed and his associates in their historic experiments in Havana.

The filterability of *L. icteroides* conforms with one of the most important characteristics of the yellow fever virus, and in this respect *L. icteroides* differs from all organisms previously thought to be the cause of yellow fever.

Cultural Properties of Leptospira icteroides.

An interesting point in connection with the cultivation of *L. icteroides* is the adjustment of reaction of the culture medium. In an earlier publication [21] it was stated that growth of the organisms occurs in the "leptospira medium" [1] when the hydrogen-ion concentration is between pH 6 and pH 7·4. The question has recently been restudied with the collaboration of Dr. Telémaco Battistini [24], not only with *L. icteroides*, but also with *L. icterohæmorrhagiæ* and *L. hebdomadis*, and it has been found that all three species of leptospiras grow well between pH 5·45 and pH 7·21, but not at all at pH 4·65 or pH 8·19. The *icteroides* undergoes degenerative changes much sooner at pH 7·21 than at 5·45 to 6·26, while *L. icterohæmorrhagiæ* and *L. hebdomadis* are as active at pH 7·21 as at pH 5·45. It is evident, therefore, that *L. icteroides* prefers slight acidity and scarcely tolerates an alkalinity beyond pH 7·21. In view of the alkalinity which may be introduced into carefully adjusted media by the use of ordinary soft glass test-tubes, particularly when they have been used for some time, it is well to adjust the culture medium to a point near pH 6 instead of pH 7·4, as formerly recommended. Many of the irregular results previously obtained in the cultivation of *L. icteroides* are undoubtedly explained on the basis of unsuitable reaction of the culture medium employed.

In the light of the exact determination of the hydrogen-ion concentration for the growth of *L. icteroides*, and of the recent work of Rous [25] on the pH of various animal tissues, it becomes evident why the organism does not multiply in the blood or body fluids of which the pH ranges from 7·6 to 8·2, as in the case of man and some animals. Rous found that the pH of the liver and the kidney in a mammalian (mouse), on the other hand, varies from 5·4 to 6·6, hence they offer an optimum reaction for the multiplication of *L. icteroides*. The particular attack of yellow fever on these two organs may perhaps be partly explained by this factor. *L. icterohæmorrhagiæ* shows similar, though less pronounced, predilections. All the organs or tissues spared by yellow fever have a pH either too acid or too alkaline for the survival and multiplication of *L. icteroides*. The pH range of *L. icteroides*, in comparison with that of most pathogenic bacteria, is rather narrow.

The disappearance of *L. icteroides* from the liver and kidney of experimental animals (young guinea-pigs, puppies, and certain monkeys) is proportional to the degree of histological (hence functional) changes induced by the invading organisms. The more profound the changes, the fewer the surviving organisms, until none at all can be found when the injuries reach a certain limit. The cessation of physiological function of the involved organs and consequent lack of nutrient substances leads to the total disappearance of the *icteroides* towards the later stage of a fatal infection. The phenomenon is perhaps somewhat more constant and rapid in human yellow fever than in experimental animals, but it is marked in the monkey, *C. macrocephalus*, in which *L. icteroides* induces an infection comparable in every respect to human yellow fever [7], [13]. The disappearance of *L. icteroides* from the entire system in the case of a non-fatal infection is obviously due to the appearance of specific immune substances resulting from the infection.

Differentiation of Leptospira icteroides from L. icterohæmorrhagiæ and L. hebdomadis.

While a few clinicians [26], [27] regard that yellow fever and infectious jaundice are quite dissimilar in clinical manifestations, the majority of those who have had experience with both diseases agree that the essential features are similar [2], [28], [29]. Both are characterized by sudden onset, capillary suffusion of the face and conjunctivæ at the beginning of fever, severe headache, backache, and muscular pains in the limbs, nausea, early epistaxis, &c., the preliminary symptoms leading in both diseases to jaundice, acute nephritis, and hæmorrhages. The so-called Faget's sign, or relatively slow pulse with high temperature, is present in both diseases. Herpes labialis,[1] considered by some as almost pathognomonic for infectious jaundice, is also observed in yellow fever patients [21].

Some have laid stress upon the paler character of the jaundice in yellow fever, but all grades and all shades of colour, from pale lemon to deep orange, have been met with in both diseases. The clinical difference between yellow fever and infectious jaundice appears to be the somewhat slower course and usually less fatal character of the latter infection. In yellow fever death may occur in five to seven days, while in infectious jaundice the greatest mortality is between the ninth and eleventh days. In some cases of in-

[1] The formula for this medium is as follows:—

0·9 per cent. NaCl	800 parts.
Fresh rabbit serum	100 ,,
2 per cent. nutrient agar (pH 6·5—7·0) ...	100 ,,
Rabbit hæmoglobin (made by laking one part of the defibrinated blood with three parts of distilled water)	10-20 ,,

[1] Herpes labialis has now been shown to be an independent infection caused by a filterable virus. It may occur in association with a number of diseases, hence it has no significance for diagnosis.

fectious jaundice there may be a second rise of temperature towards the end of the second week, but many patients recover without relapse [31]. Relapses have also been known to occur in yellow fever, and are regarded as of unfavourable prognosis [32].

Seven-day fever [33] is also characterized by jaundice, hæmorrhages, and nephritis, but all of a far milder degree than in yellow fever or infectious jaundice.

Morphological Differentiation.

The most reliable means of morphological differentiation is the study of cultures under the dark-field microscope. It is understood that for the purpose of comparison the culture media must be identical in composition and hydrogen-ion concentration, and the cultures must be of the same age and grown under the same conditions of temperature. With the co-operation of Dr. Battistini [24] comparative studies of this kind have been made.

L. icteroides is decidedly shorter (4 to 14 μ) and somewhat thinner (0·2 μ) than *L. icterohæmorrhagiæ*. The elementary spirals are less closely set. The shorter forms assume a semi-oval circle, the longer specimens show greater flexibility, doubling up at any angle. All rotate swiftly, with some lateral vibratory movements.

L. icterohæmorrhagiæ is considerably longer than *L. icteroides* (8 to 24 μ), usually more uniform in length and heavier in aspect. The elementary spirals are more closely set, although in a very long specimen the spirals are somewhat looser. They have the well-known hooked ends and straight bodies, and rotate swiftly and gracefully without lateral vibration.

L. hebdomadis averages slightly longer (10 to 30 μ) than *L. icterohæmorrhagiæ*, and the elementary spirals are almost geometrically equidistant and distinct. The organisms rotate swiftly and evenly without relaxation of the elementary spirals and without bending the ends into a hook, the body being almost a straight line in living forms. Killed specimens have the characteristic hooked ends of a leptospira. Occasionally one observes living organisms showing a small hook at one end, but they soon stretch out with change of movement. There is no difficulty in distinguishing this species from the other two.

Stained preparations may also be used for differential purposes. Leptospiras do not stain readily, especially in culture on the semisolid leptospira medium which gives the richest growth. The best results are obtained by fixing the culture organisms in buffered formalin [34] and staining the dried, thin films with a saturated alcoholic solution of basic fuchsin or gentian violet for a few seconds, or with Giemsa's solution (1 in 20 in distilled water) for two hours. Osmic acid fixation of the wet film, followed by staining with Giemsa solution, also gives good results. In well-stained preparations the elementary spirals can be easily recognized. The thin, delicate, rather short hooked forms of *L. icteroides* can be distinguished from the somewhat heavier and longer *L. icterohæmorrhagiæ* with terminal hooks and the rather straight and coarser *L. hebdomadis*. It is essential for the purpose of comparison to use cultures grown under identical conditions and stained in the same dye solution.

I have had opportunity recently to show cultures of the three leptospiras to Professors Inada, Brumpt, Calkins, Iturbe, and others, all of whom recognized the morphological differences between the species.

Immunological Differentiation.

In the earlier experiments [35] it was shown that *L. icteroides* and *L. icterohæmorrhagiæ* can be distinguished by means of monovalent immune sera. Recently Dr. Battistini [24] has undertaken anew a determination of the immunological relations between *L. icteroides*, *L. icterohæmorrhagiæ* and *L. hebdomadis*, growing the organisms on culture media containing 10 and 1 per cent. of monovalent immune rabbit sera. It has been found that the different strains of *L. icteroides* (from Guayaquil, Mexico, Peru, and Brazil) undergo agglutination and disintegration when inoculated into media containing anti-*icteroides* immune sera, but grow well on media containing anti-*icterohæmorrhagiæ* or anti-*hebdomadis* immune sera. Conversely, the strains of *L. icterohæmorrhagiæ* (obtained from sources in the United States [36], Ecuador [37], and Sumatra [38]),[1] undergo similar changes in media containing anti-*icterohæmorrhagiæ* sera, but grow luxuriantly in media containing anti-*icteroides* or anti-*hebdomadis* immune sera. In the same way, anti-*hebdomadis* sera affect only *L. hebdomadis*.[2]

The experimental infection with *L. icteroides*, like human yellow fever, confers a lasting immunity. As has already been mentioned, the serum of persons recently recovered from yellow fever contains certain immune principles which produce the Pfeiffer phenomenon with *L. icteroides*. Parallel reactions with *L. icterohæmorrhagiæ* have been uniformly negative, and normal sera invariably give negative reactions with both organisms. The duration of the Pfeiffer phenomenon has not been determined but is variable in different individuals. Positive reactions were obtained with the sera of five convalescents in Peru [5], and in the case of two persons who had had yellow fever as long previously as ten and eleven months, while in two other persons who had had the disease ten months previously the reaction was incomplete or doubtful. In Guayaquil [40] fifteen of eighteen convalescents or recovered persons gave a positive reaction; in Colombia and Brazil the reaction was positive in all cases studied. Pérez Grovas [10] found that the reaction was not present as early as the eighth day (one case), but was constantly present after the twelfth day (seventeen cases). There are two instances on record of long duration of the Pfeiffer phenomenon. One is that of Dr. Henry Hanson, a sanitarian [41] who had had severe yellow fever four years previously and had remained in an infected area for two years afterwards; a strong positive reaction was obtained with his serum. Dr. Kligler, who had a sharp attack of yellow fever in Morropón in 1920,

[1] I am indebted for several strains of *L. icterohæmorrhagiæ* to Professor G. Baermann, of Petoemboekan Hospital, Sumatra.

[2] Two strains of *L. hebdomadis* have been obtained through the kindness of Professor R. Inada, Tokyo Imperial University.

and recovered promptly following the administration of anti-*icteroides* serum by Dr. Caballero within forty-eight hours of onset, recently found that his serum still gave a mild positive reaction (four and a half years).

Pérez Grovas [10], employing the strain of *L. icteroides* isolated by him in Vera Cruz [4], studied 183 cases of yellow fever for the purpose of determining whether specific agglutinins for *L. icteroides* could be demonstrated, and found that agglutination tests were more sensitive than Pfeiffer reactions, and that the agglutinating properties of the serum in yellow fever are constantly demonstrable, and as early as the beginning of the second week, that is, earlier than the Pfeiffer phenomenon. Sera from twenty-three normal individuals, and from seventeen persons suffering from diseases other than yellow fever, and sera from persons who had had yellow fever years previously, gave negative agglutination reactions. Positive reactions were obtained in seven of eleven vaccinated persons who had received the second injection of vaccine eleven to fifteen days previously.

The various immunological experiments described clearly establish the immunological entity of *L. icteroides*.

The Non-contagiousness of Infection with Leptospira icteroides.

Like most insect-borne infectious diseases, yellow fever is not transmitted from person to person by direct contact. The excreta and vomitus are not infectious, and only in a few instances out of hundreds of autopsies has it been suspected that a physician performing post-mortem examination has acquired the infection by this means. Generally speaking, the performance of autopsies on yellow fever cadavers is without danger, owing undoubtedly to the disappearance of the virus before death occurs.

L. icteroides behaves much the same with respect to contact as does the virus of yellow fever. Among hundreds of susceptible young guinea-pigs which have been kept in the same pens or cages with fatally infected animals, not a single instance of contact infection has been observed, notwithstanding the animals shared the same food, and the well lived amidst the excreta of the sick. When a fatal *icteroides* infection has been allowed to run its natural course, and the liver and kidneys reveal profound fatty degeneration and necrosis, blood or organs taken at autopsy are seldom infectious, and *L. icteroides* is recovered from such animals only in a small percentage of instances. In the Brazilian monkey, *C. macrocephalus*, in which typical yellow fever was allowed to run its course, no leptospiras could be demonstrated in the material obtained at autopsy.

Ædes ægypti, Yellow Fever, and Leptospira icteroides.

The theory of Finlay that *Ædes ægypti*, formerly called *Stegomyia calopus*, transmits yellow fever from man to man, was first experimentally demonstrated in Havana in 1900-1901 by the Yellow Fever Board of the United States Army under Major Walter Reed. Non-fatal yellow fever was induced in eighteen non-immune volunteers by subjecting them to the bites of mosquitoes twelve days or longer after the insects had bitten patients who were in the early stages of yellow fever (one to three days after onset). A single experiment was made with a mosquito which had sucked the blood of a patient four days after onset of yellow fever, and a negative result obtained, but inasmuch as some mosquitoes which had ingested blood during the first three days of illness failed to infect under the same conditions, the Board did not conclude that the virus is not present in the blood later than three days [42]. The French Commission to Brazil obtained negative results in three instances in which blood taken on the fourth day of illness was inoculated into normal persons [20], hence they considered that the virus probably disappears from the blood circulation about this time.

With regard to the incubation period of the virus of yellow fever in the mosquito, that is, the period between the infecting meal and the time when the mosquito actually becomes infective, the report of the Army Board states that the exact length of the period could not be determined, inasmuch as no experiments were performed with contaminated mosquitoes between the eighth day after the infecting meal, when the result was negative, and the twelfth day, when the mosquitoes were found to have become capable of conveying infection. Carter [50], before the experimental demonstration of mosquito transmission of yellow fever, had determined, by painstaking study of an epidemic in Orwood, Miss., that there was a definite interval between the occurrence of yellow fever in a given house and the time when the house became a source of infection. When all other sources of infection could be excluded, he found that the interval between the first (primary) case of yellow fever and the secondary cases in a given house varied between eleven and a half and twenty-three days. Hence, when we subtract the period between exposure and onset, about three days at the shortest, the minimum period of incubation of the virus in the mosquito becomes about eight and a half days. Reed [43], in comparing the Board's experimental results with the empiric observations of Carter, expressed the opinion that the minimum period of mosquito incubation might be about ten days. Notwithstanding these definite indications that the period is as short as eight and a half to ten days, however, it is usually referred to in the literature as twelve days.

When *L. icteroides* was first isolated in Guayaquil, the question of mosquito transmission of the organism immediately suggested itself, and experiments were undertaken to determine whether the experimental, as well as the human, infection could be transmitted by *A. ægypti* [44]. Six experiments were carried out with mosquitoes infected from human beings, and in one of the six (in which eight insects were used) typical experimental yellow fever was induced in guinea-pigs by the bite of mosquitoes fed twenty-three days previously on a yellow fever patient. In a parallel series of experiments in which the insects

were fed on experimentally infected animals, two guinea-pigs developed the typical infection, one of which had been bitten by nineteen mosquitoes infected eight and twelve days previously, and the other by eighty-three mosquitoes fed eight days previously. Twenty-five mosquitoes of the latter lot were emulsified in Ringer solution two days later and the entire suspension, in which a small number of leptospiras was demonstrated by dark field examination, inoculated into a young guinea-pig. The animal developed typical infection and died eight days later. *L. icteroides* was demonstrated in all of the animals infected by mosquitoes. Another group of the infected mosquitoes was placed in 10 per cent. formalin and brought back to the Rockefeller Institute, but impregnation of the mosquito tissues with silver nitrate made them so powdery that they were useless, hence the study of the distribution of the leptospira in the mosquito body had to be postponed until opportunity for further study should present itself.

The successful transmission of experimental yellow fever from guinea-pig to guinea-pig by means of mosquitoes which, in one instance, had had their infective feeding only eight days previously, cannot be regarded as conflicting with the data obtained in man, for reasons already stated.

Iglesias [45], head of the Vera Cruz yellow fever laboratories of the Mexican Department of Health, was successful in infecting mosquitoes by feeding them on an infected guinea-pig and in transmitting the infection subsequently from the mosquitoes to normal guinea-pigs. Two animals, exposed to the bites of the infected mosquitoes twenty-three and thirty-one days, respectively, after their infecting meal, showed suggestive symptoms of mild experimental yellow fever, and in the transfer from one of them the leptospira was demonstrated in the blood.

The experiments so far made are sufficient to establish the fact that the virus of yellow fever and *L. icteroides* are alike transmissible by *A. ægypti*.

Application of Immunity Phenomena to Prophylaxis and Serum Treatment of Yellow Fever.

As is well known, there are a few instances in which killed cultures of pathogenic micro-organisms are capable of inducing immunity to subsequent infection with virulent strains. An attack of yellow fever confers lasting immunity, and the question at once arose whether the injection of killed cultures of *L. icteroides* would induce appreciable protection against the living organism.

Experiments on guinea-pigs were undertaken by Pareja and myself [46] immediately after the isolation of *L. icteroides* in Guayaquil, and it was found that animals which had received killed cultures resisted subsequent infection. In view of this result, we were asked to inoculate a large number of non-immune soldiers who were to be transferred from non-infected regions to Guayaquil. Of 149 soldiers vaccinated in Quito, 29 received 2 c.c. of killed cultures, the remainder 1 c.c. Among the latter group three later contracted yellow fever. Among another group of 176 soldiers and their families, vaccinated after arrival in Guayaquil with a vaccine preparation about one-fifth the strength of that used in Quito, two cases of yellow fever developed. One may be regarded as a control, in that it developed shortly after vaccination, before immunity could have developed.

The relatively small incidence of yellow fever among the vaccinated group, as compared with that among the other non-immune population of Guayaquil, indicated that it was desirable to continue trial of the vaccine, and subsequent preparations have been of a strength such that one cubic centimetre contains 2,000,000,000 leptospiras, as compared with 2,000,000 in the earlier preparation. Two injections of 2 c.c. of the vaccine are administered whenever possible. This material has been used extensively in Mexico, Peru, Salvador, Guatemala, British Honduras, Brazil, and the West Coast of Africa, more than 20,000 individuals having been vaccinated. Although in many instances the vaccinated were not subsequently exposed to yellow fever, owing to the decline of the epidemic or to their having left the epidemic area, there were nevertheless a large number whose immunity was subjected to test. Table II shows the relative case incidence of yellow fever among vaccinated and unvaccinated in various epidemics during the course of the past six years. There are two groups, those who contracted yellow fever before sufficient time had elapsed after vaccination for immunity to develop (a period of ten to fifteen days being required), and those taken ill later than this period. Although many cases have occurred during the pre-immunity period, only rarely has a vaccinated person contracted yellow fever later, notwithstanding the high case-incidence among unvaccinated during the same period. The pre-immunity cases may be regarded as controls, and the occurrence of yellow fever among them as showing that vaccinated persons were exposed to yellow fever equally with non-vaccinated, while the abrupt drop in incidence among vaccinated after the fifteen-day period, notwithstanding continued occurrence of cases among unvaccinated, indicates that the vaccination confers protection against infection. The protection induced by vaccination lasts about five to six months.

The presence of immune substances in the serum of persons who have recovered from yellow fever, as shown by the Pfeiffer reaction, is not so permanent as the immunity of the body as a whole. Persons who have had yellow fever years ago remain immune, though their serum may not give a positive Pfeiffer reaction, hence the immunity induced by natural infection must be due to at least two factors, one humoral, more transient, the other histogenous and lasting. Only the former is transferable to non-immune persons, and the serum of yellow fever convalescents is useful for treatment in proportion to the amount of immune substance present [20], [39].

It is possible, however, to produce immune substances artificially in enormous quantity in the serum of certain naturally less susceptible animals by

TABLE II.—VACCINATION AGAINST YELLOW FEVER.*

Place and population	Year	Number vaccinated and physician in charge	Number cases yellow fever among vaccinated: Before 10 days † 1 inj.	Before 10 days † 2 inj.	After 10 days 1 inj.	After 10 days 2 inj.	Number cases yellow fever among unvaccinated during same period	Incidence: Among vac.	Incidence: Among unvac.
Ecuador ‡	1918	Noguchi and Pareja							
Quito §		149	0	0	3‖	0			
Guayaquil		176	1	0	2¶	0	386	11 per 1,000	110 per 1,000
		Board of Health 102	0	0	0	0			
Honduras		Lyster, Pareja, and Bailey							
U.S.S. Chicago	1919	75	0	0	0	0			
Amapala	1919	425	0	0	0	0			
Salvador		Lyster and Bailey							
113,000	1920	3,469 (1 inj.) / 138 (2 inj.)	5	0	5**	0	181		
Guatemala		Lyster and Vaughn							
	1920	791 (1 inj.) / 592 (2 inj.)	1	1	0	0			
Mexico		Lynn and Guadarrama							
Tuxpam, 6,000	1920	2,000 (2 inj.)	0	17	0	0	85	0	21·3 per 1,000
Vera Cruz	1920	Board of Health 514 (2 inj.) / 234 (1 inj.)	2	0	3‡‡	0	199		
Manzanillo	1921	Surg.-Gen. Osornio 600	0	0	0	0	"Numerous"		
Honduras (Brit.)		Gann							
Belize	1921	146	0	7	0	0			
Peru	1920	Noguchi and Kligler							
Tambogrande, 500		47	0	1	0	0	17	0	3·4 %
	1921	Hanson							
Paijan		200	0	0	0	0	"Numerous"	0	
Lambayeque		200	0	0	0	0	,,	0	
Brazil		Broad St. Hosp., N.Y.							
Ceará (D.P. Robinson Co.)	1922-23	57	0	0	0	0	"10 per month"	0	
		Thomas 68	0	3	0	1††	22		

* These figures include only persons vaccinated while in an endemic or epidemic area, or about to enter such an area, that is, persons who were subject to exposure to yellow fever after vaccination.

† The cases recorded in this column were in persons who were already in the epidemic area when vaccinated, and who contracted yellow fever before there had been sufficient time (ten to fifteen days) for the development of immunity.

‡ The vaccine employed during these preliminary experiments in Ecuador contained about 2,000,000 organisms per c.c., while that used on all subsequent occasions was a thousandfold stronger (2,000,000,000 organisms per c.c.).

§ The vaccinations were carried out in Quito on September 24, 1918, and the vaccinated troops arrived in the epidemic area (Guayaquil) on October 7.

‖ Received 1 c.c. only.

¶ The supply of vaccine being almost exhausted, the remainder was diluted. In this instance only 1 c.c. of the diluted vaccine was injected.

** Incomplete vaccination (1 injection only). In two of these cases the diagnosis was doubtful.

†† This is the only case recorded in which yellow fever occurred notwithstanding two injections of vaccine and a lapse of time ample for development of immunity. The patient received anti-*icteroides* serum on the second and third days of illness and recovered.

‡‡ Incomplete vaccination (1 injection only).

repeated injections at regular intervals of living cultures of *L. icteroides*. During the past several years we have been able to prepare[1] in horses an immune serum such that a quantity as small as 0·0001 c.c. is capable of protecting a guinea-pig against 1,000 minimum killing doses of *L. icteroides*, when given simultaneously. Such potency is never found in the serum of yellow fever convalescents. Somewhat larger quantities of the serum save guinea-pigs already infected, when administered during the early period (the first three days) of illness. There was sufficient justification, therefore, for employing this immune serum in the treatment of yellow fever in man.

The first use of the anti-*icteroides* serum in human yellow fever was by Lyster, Pareja and Bailey in 1919, and favourable results were reported [47]. Treatment was continued by Lyster and his associates in the Central American countries and in Mexico, in British Honduras by Cran [48], and later in various localities. The results are summarized in Table III.

The statistics clearly indicate the efficacy of the serum when administered during the first three days

[1] This work has been conducted under my direction by Mr. Julius Klosterman.

TABLE III.—SERUM TREATMENT OF YELLOW FEVER.

Place	Year and physician in charge	Serum administered before fourth day			Serum administered after fourth day			Mortality among untreated cases during same period
		Total	Rec.	Died	Total	Rec.	Died	
Salvador	Lyster and Bailey, 1920	14	11	3*	28	15	13	51 per cent.
Guatemala	Lyster and Vaughn, 1920	3	3	0	1	0	1	68 ,,
Honduras	Lyster, Pareja and Bailey, 1919	1	1	0	—	—	—	
Honduras (Brit.)	Gann, Cran, 1921	12	11	1	4	0	4	
Mexico								
Mérida	Hernandez, 1920	4	4	0	4	0	4	80 ,,
Vera Cruz	Board of Health, 1920	16	16	0	3	0	3	49 ,,
Gutierrez-Zamora	Le Blanc's Report, 1920-1921	17	17	0	1	0	1	3 cases untreated, all died.
Tuxpam	Lynn and Guadarrama 1920	36	27	9	38	21	17	68·8 per cent.
Peru	Noguchi and Kligler, 1920	4	3	1†	—	—	—	
,,	Hanson, 1921	8	6	2‡	—	—	—	"Up to 100 per cent."
Brazil	Barreto, 1920	4	2	2	2	1	1	
,,	Borges Vieira, 1920	—	—	—	1	0	1	
,,	Cavalcanti, 1920	12	11	1	5	4	1	
,,	Thomas, 1923	12	8	4	—	—	—	
West Africa								
Nigeria	Leonard, 1922	1	1	0	—	—	—	1 case untreated, died.
Grand Bassam	Bauvallet, 1922	4	3	1	2	0	2	
	Total	148	124	24	89	41	48	

* Received total of 20 c.c. in two days—"too small an amount to have any material effect" (Dr. Bailey).
† Patient subjected to forced journey during first two days of illness; disease extremely severe; patient exhausted, with severe nephritis, when admitted to hospital.
‡ Day of disease on which serum was given not recorded.

of illness, the mortality being 16 per cent. as against 50 to 100 per cent. during the same epidemic period among cases treated after three days or not treated with serum at all.

It is understood, of course, that serum treatment must be accompanied by reasonable symptomatic treatment. It is well known that undue physical exertion may bring about a fatal termination even in mild yellow fever, and that rest, proper nursing, and suitable diet (Carter recommends no food but plenty of water) are essential [49]. The effect of the serum is indicated, according to those who have used it, not only by the reduction in mortality but in the prompt alleviation of symptoms [6].

RELATION OF VACCINATION AND SERUM TREATMENT TO SANITARY REGULATIONS.

When specific prophylaxis and serum treatment for yellow fever were suggested, special emphasis was placed upon the fact that they were supplementary means of fighting the disease and would not supplant the method of elimination by mosquito control [51]. They were intended, the one to give non-immune persons temporary protection until the mosquito index is sufficiently reduced for safety, the other to give the patient the benefit of a curative serum without neglect of the usual symptomatic care [52].

Protection induced by the use of killed micro-organisms is, in general, not so durable or complete as that brought about by spontaneous infection or by modified live virus such as is used for small-pox vaccination. Moreover, the proof of effective cow-pox vaccination can always be seen in the local manifestations, and the presence or absence of protection against small-pox in a vaccinated person is readily determined by the outcome of subsequent vaccination. Hence a certificate of small-pox vaccination can very well be accepted in lieu of quarantine. In yellow fever[1] we have no parallel procedure to which we may resort in order to prove that all vaccinated individuals are protected. But since susceptible animals become resistant to the *icteroides* infection after inoculation of killed cultures, and since the blood serum of vaccinated persons acquires protective property against *L. icteroides*, as shown by tests in guinea-pigs, it is assumed that vaccinated persons are protected, and this assumption seems to be well borne out by the actual results obtained with yellow fever vaccine in several thousand human beings, as already described. Results analogous to those obtained in yellow fever, and also decidedly favourable, have been reported by Inada on the use of vaccine and serum against infectious jaundice in Japan [54].

The efficacy of vaccination against yellow fever has therefore been substantiated, as was that of antityphoid vaccination, and its use in combination with other prophylactic measures has been generally adopted. It may be said, as was said by Russell [53] in connection with antityphoid vaccination, "there is no occasion for conflict between the advocates of general and individual prophylaxis; one is as necessary as the other, and no one interested in the suppression of this disease can afford to ignore either."

SUMMARY.

The properties of *L. icteroides* are the same as those already demonstrated for the virus of yellow fever: it passes through bacterial filters; it is killed by a temperature of 50° C. maintained for five

[1] The basis for yellow fever vaccination is analogous to that for vaccination against typhoid fever, and the same general laws apply to both.

minutes; it is transmissible from man to animal and from animal to animal by means of infected female *A. ægypti* mosquitoes. *L. icteroides* is invisible under the ordinary microscope but visible by dark-ground illumination.

L. icteroides induces a symptom complex and pathological changes in suitable experimental animals (young guinea-pigs, puppies, and certain monkeys) which are identical with those of human yellow fever.

Yellow fever and infectious jaundice are distinct, independent infections. They are very similar in character.

L. icteroides is distinct, both morphologically and serologically, from *L. icterohæmorrhagiæ* of infectious jaundice and *L. hebdomadis* of seven-day fever.

The prophylactic value of the vaccine prepared with killed cultures of *L. icteroides* and the efficacy of the anti-*icteroides* immune serum prepared in horses were demonstrated in animal experiments and have been substantiated by the results of vaccination and serum treatment in human beings.

The evidences just summarized appear to warrant the conclusion that *L. icteroides* is the cause of yellow fever.

There is no reason for modification of any of the established measures of general prophylaxis or sanitary regulations now in force against yellow fever; specific prophylactic measures and serum treatment should be employed simultaneously with the anti-mosquito campaign and the proper symptomatic treatment of yellow fever.

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BRITISH INDIANS AND BILHARZIA DISEASE.

By F. G. Cawston, M.D.Cantab.

In the *Indian Journal of Medical Research*, vol. vii, No. 1, July, 1919, Mr. Stanley Kemp and Dr. F. H. Gravely published a carefully written paper "On the Possible Spread of Schistosomiasis in India." The danger was accentuated by the return of troops harbouring *Schistosomum mansoni* and *S. hæmatobium*,

which infection they had acquired whilst on active service in Egypt. At that time little was known of the extent to which the problem of *S. japonicum* had reached in southern China, nor was this condition recognized as a possible menace to health on the north-eastern frontier of India; however, the various schistosomes, which Mr. R. E. Montgomery had described in his "Observations on Bilharziosis among Animals in India," in the *Journal of Tropical Veterinary Science*, 1916, vol. i, indicated that other than the common bilharzia parasites of man might possibly be found in India, and this danger was confirmed by Mr. B. B. Seymour Sewell's description of "Cercariæ Indicæ" in the *Indian Journal of Medical Research* for June, 1922. In the July number of this journal for 1921, Dr. M. B. Soparkar had published some "Notes on some Furcocercous Cercariæ from Bombay," but there was little or no evidence to prove that any of these cercariæ represented the larval stage of human parasitic worms.

In the course of a paper which appeared in the *Indian Journal of Medical Research* for 1920, entitled "Is Human Bilharziosis likely to spread to India?" Dr. M. B. Soparkar makes the interesting statement that "On the occasion of a recent visit to our laboratory, Major Christophers informed us that his patient had been to Africa, though this is not stated in his published account." This patient's urine contained spindle-shaped ova in addition to the usual terminal-spined ova of patients infested with *S. hæmatobium*, as reported by Dr. S. R. Christophers and Dr. J. W. W. Stephens in the *British Medical Journal* for 1905, vol. v, page 1289. Indians in Natal are very susceptible to invasion by the bilharzia parasites, and some of those who acquire the infection here make occasional visits to various parts of India, more particularly to Madras.

Undoubtedly *S. hæmatobium* is the commonest schistosome in these patients, and I have found it present in all cases that are suffering from bilharzia infection, even though they may also be harbouring *S. mansoni* or passing in their urine the spindle-shaped ova, which usually measure 0.24 mm. in length and have been regarded as the ova of *S. bovis*, which has been shown to occur in the pools from which the majority of these cases have acquired the infection.

Dr. Andrew Balfour has directed my attention to the report of Giulio Bertolini on "*Bilharzia crassa* and the lesions caused by it," which appeared in *La Clinica Veterinaria*, Part 1, 1908. The eggs of this parasite would appear to differ from those found by Sonsino in Egyptian cattle, and the lesions caused by this parasite are less severe than is common amongst cattle in Egypt. It occurs in 9 per cent. of Sardinian cattle.

The identity of the parasite which attacks human beings in Natal remains uncertain until an example of the adult worm is available; in fact, from the ova some of these cases have been suspected as being *S. spindalis* (Montgomery). The symptoms would appear to be slightly more severe than is common with *S. hæmatobium* infection alone, for these patients have submitted themselves for treatment during the first month or two after the hæmaturia was noted, which is relatively uncommon with other patients, many of whom suffer for years before deciding to undergo treatment. At the same time one Indian patient came to me for treatment with ten years' history of *S. hæmatobium* infection, and a schoolboy with infection due to *S. hæmatobium* AND *S. ? bovis* gave only about ten weeks' history of hæmaturia. Unlike the cattle condition, it is difficult or impossible to find the ova in the fæces or in rectal wash, even by the floatation method; though I have obtained the ovum from the rectum in one small native boy. Although the ova are less numerous than those of *S. hæmatobium*, they are readily detected in the centrifugalized urine, and are easily told from the common variety because of their length and narrower appearance. Some experiments which I made to secure the cercariæ from miracidia obtained from these spindle-shaped ova, using examples of *Physopsis africanus* (Krauss), proved negative.

Whilst on active service in 1916 I drew the attention of the military authorities in South Africa to the danger of *S. mansoni* infestation becoming endemic in South Africa, a danger which was aggravated by the fact that troops were returning from Egypt and many were remaining at Durban, where the intermediate hosts for both *S. hæmatobium* and *S. mansoni* were breeding in enormous numbers without any serious efforts being made to clean up the infected areas. In fact, I actually treated some troopers who claimed to have acquired bilharzia infection through bathing in the Umbilo river whilst encamped at Congella. At that time *S. mansoni* infestation was unknown in South Africa, except in native labourers who had been imported from Portuguese East Africa for work on the Johannesburg mines. The presence of this parasite, along with *S. hæmatobium* in some schoolboys that I was treating at Durban during the next few years, was not considered sufficient evidence of a recent introduction of the parasite to Natal, as it was felt that the parasite might have existed in Natal previously, or might occur sporadically in any infested district; but the fact that others besides myself have found the lateral-spined ovum in the urine of bilharzia patients only during the last year or so, and the fact that two such cases have occurred in a fortnight at Durban, indicates that there is a real danger of this parasite becoming a menace to the health of Natal, especially as these two cases were suffering from dysenteric symptoms which had not been noted in the other patients who harboured both varieties of the bilharzia worm. Meanwhile, the pools which I have shown to be infested with *S. hæmatobium*, *S. bovis*, *S. mansoni*, and enormous numbers of fresh-water snails infested with *Fasciola gigantica*—the very same pools from which I assisted Dr. Annie Porter to obtain the examples of *Limnæa natalensis* (Krauss), from which we both obtained the carcariæ which grew into the adult *F. gigantica* in 1919—remain a constant source of danger to Durban, because of the numbers of European children, Indians and natives who bathe and fish in them. Parasitic diseases of this kind are less easy to control amongst Indians

than amongst Europeans, and it might be useful for the Indian Government to make representations to the Union Government in order that suitable efforts may be made to safeguard the large number of Indian school children in Natal from the possible invasion of bilharzia parasites.

Studies of fusiform Bacilli and Spirochætes (Further Observations on the Distribution about the Genitalia of Normal Women and Their Significance in Certain Genital Infections and Tumors) (I. Pilot and A. E. Kanter, *Arch. Dermatology and Syphilology*, vol. 10, No. 5, November, 1924).—Fusiform bacilli as well as spirochætes are frequently present in the smegma secretion of a normal woman. They are usually absent in the cervix and vaginal tract. They play no rôle in the production of leukorrhœa, they are important infecting agents of the vulva, erosive and gangrenous, vulvitis, condylomatous, acuminate, necrotic fibroids and carcinoma of the uterus and vagina. Infection with these organisms is characterized by necrosis and foul odour. The presence of these organisms normally would indicate that many ulcerative processes about the genitalia are due to autogenous infection and are not necessarily the result of bacteria from other sources.

Precipitation and Complement-fixation Reactions with Residue Antigens in the Non-Hæmolytic Streptococcus Group (Charles H. Hitchcock, M.D., *Journal of Experimental Medicine*, November 1, 1924).—The applicability to the non-hæmolytic streptococci of the technique used for the extraction of a soluble precipitating substance from the hæmolytic streptococci is demonstrated. With this substance as antigen, it is demonstrated by means of precipitation and complement-fixation that the non-hæmolytic streptococci form an antigenically distinct, but entirely heterogeneous group. Such cross reactions as do occur within this group are not useful in the systematic classification of these organisms.

The Effect of Heat on Flagellar and Somatic Agglutination (Marion L. Orcutt, *Journal of Experimental Medicine*, November 1, 1924).—Heat at 70° C. destroys the form of the flagella and their ability to combine with flagellar agglutinins, but it does not destroy their antigenic nature, since they can still generate flagellar agglutinins in the animal body. Heat at 70° C. and even at 120° in the autoclave does not destroy the forms of bacilli themselves nor their ability to become agglutinated and to absorb agglutinins. Somatic agglutinins are destroyed to a considerable extent by heat at 70° C., and completely destroyed by heat at 75° C. Heat at 70° C. causes little or no destruction of flagellar agglutinins, but a temperature of 75° changes the agglutinins so that they react more slowly and produce a slightly lower reaction with a zone of inhibition in the stronger dilutions.

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A WHITE AUSTRALIA: IS IT A POSSIBILITY?

By SYDNEY J. SKERTCHLEY, J.P.

(*Continued from page* 180.)

CHAPTER XIII.

Birth-rate in Australia.

IT may, and doubtless will be academically argued that to lower the death-rate, that is to make a land

healthier, must react upon the birth-rate by improving the physique. It seems so logical an inference that it appears to have been accepted as axiomatic. Yet it is not true. If it were we should invariably find that as the death-rate fell the birth-rate rose. But it does not. If it did, then in the United States and Australia the birth-rate should have steadily risen as scientific methods prevailed, but we have seen it has steadily fallen as life has been lengthened.

It may be painful to (some) scientific minds to have to admit total ignorance. But it must be done sometimes, and the laws which regulate reproduction are among the mysteries yet unsolved. At least, they are for me. I do not know why the pretty moth *Ciaaria sagittata*, only lives in a very limited area near Chatteris, Cambs., though its food-plant abounds everywhere in the surrounding Fens. I do not know why the swallow-tail butterfly in England cannot live except in certain limited areas of those same Fens and Broads, while on the Continent it roams over the gardens and feeds on carrot-tops; especially I do not know why in captivity it relishes and thrives on the said carrot-tops which it will not touch when at large in England while it thrives on them in France. I do not know why the Ammonites gave up the ghost at the close of Cretaceous times, while the *Nautilus* lives on. I do not know why *Lantana* and the Sensitive Plant have over-run Southern Asia, and while both swarm in Hong-Kong, only *Lantana* has made itself a pest in Australia. I cannot see why the *Ichthyosaurus* should have died out and the *Ceratodus* survived in Queensland. Forty years of thought and reading have left the question of distribution of species quite unanswered, in spite of much literature. And distribution depends on reproduction; no species can permanently colonize unless its natural increase overmasters the death-rate; neither can man.

So with this question of human natural increase; we can only say that neither climate, habit, nor hygiene, has more than a modifying influence. Something, one knows not what, lies deep at the root of the matter. It is this that kept the Roman Empire within ethnographic limits; it was this that prevented the Fair Whites holding all Europe when it was in their grasp; it is this that has brought about in the United States, and is bringing about in Australia, not merely individual decadence, but the decadence of the race as a whole. It is because no one, to my knowledge, has hitherto clearly grasped this, the greatest lesson of history, that folk are prone to argue about a Monroe doctrine, and a White Australia, not from the point of view of its possibility, but as a certainty whose details alone need expounding. Instead of asking How, they should begin with If.

I cannot sufficiently emphasize the healthiness of Australia. It shows itself in our diminishing death-rate. And it, above all, demonstrates it in the rate of infant mortality under one year. The details are shown in the table below showing the deaths per thousand.

These statistics prove that our rate of infant mortality has decreased from 103·61 per thousand to 81·06 since 1901, which is as low as that of Norway, and lower than any other European country. The rate for England and Wales is 132, for the German Empire 205. Well may Mr. Knibbs call this "a very enviable position." An Australian child has a better chance of getting over his critical first year than any other child on earth, and having done so has a greater chance of seeing old age. In 1907 no fewer than twenty-seven persons of 100 and upwards died in the Commonwealth; the doyen being a patriarch of 119 who had spent eighty-seven years in this country. Our land is healthy, our marriage-rate is the same as that of England, and yet our rate of natural increase has declined rapidly. This is the crude fact: if we but knew the cause we might suggest a remedy.

One of the causes of our poor natural increase I have shown to be the abnormal aggregation of our population in cities. I take it, but cannot yet prove it as true, that the birth-rate, or more strictly, the rate of natural increase, is greater in rural than urban districts. But unless this higher rate is of such magnitude as to more than counterbalance the urban deficit, the net result is merely to slow down the speed of decline; not to arrest it; still less to turn it into an advance. I am sorry to say that the material at my disposal compels me, very reluctantly, to think that our rural natural increase is a decreasing quantity.

State	1901	1902	1903	1904	1905	1906	1907
N. S. Wales	103·74	109·74	110·35	82·42	80·55	74·53	88·46
Victoria	102·94	108·60	106·40	77·92	83 30	92·92	72·60
Queensland	101·94	100·17	119·88	76·13	75·52	74·68	75·65
S. Australia	99·99	94·00	97·09	70·51	72·96	75·90	66·57
W. Australia	128·89	142·01	141·22	103·02	104·19	110·00	97·51
Tasmania	89·05	79·06	110·83	90·70	80·65	90·19	82·97
Commonwealth	103·61	107·15	111·36	81·77	81·76	83·26	81·06

I am driven to attempt to account for this sad fact in a manner which must give pain to many loyal Australians, and to suggest a remedy that will be repugnant to a large section of the community.

I am inclined to believe that some, perhaps, a considerable percentage of the comparative sterility, is due to the conditions in which the women, and to a lesser degree the young children, are placed in our rural districts, and especially in what we call the "back blocks." I have seen much of this life, and have been able to compare it with similar life in America, and I have no hesitation in saying the conditions are far harder here than there. This is true not only for the wives of the small farmer, the station hands, and general rouse-abouts, but for the middle class also, for the storekeeper's wife, and the wife of the professional man. It is sufficient to refer to what Australians think about Australian life "out back." Whether the writer's outlook be ultra-

democratic as in "The Children of the Bush," or aristocratic (if the author will pardon the adjective) as in "We of the Never-never," the same strain runs through them. It is no idyll, this woman's life at the back of beyond. It is strenuous, often grimly so; the woman works as hard as the man, often on a farm, at the self-same tasks, and this in addition to household and maternal duties. And she has no domestic help. Pride may not let us openly avow it, but this throwing of the heavy duties upon educated ladies makes the middle-class wife, and the labouring man's wife too, age prematurely; they have practically no leisure. It tells most upon the gently nurtured; the skilful fingers stiffen, the hands get spoilt, accomplishments are dropped one by one, and the care-worn soul drifts into indifference to the arts that make life truly civilized. This want of domestic help is a very real one. It is driving the American matron into the hotel and lodging house, and destroying the home life; it is doing as great an evil to the Australian without offering even such poor refuges as her American cousins flee to. Who that has lived where the black fellow remains, say, in North Queensland, has not seen the stolen picaninny "rescued" from its dusky parents, to be brought up to the blessings of civilization and "service"?

As I am writing in Australia, for Australians, I need not enlarge upon this rather painful subject. Indeed, I should barely have alluded to it, only I have found by experience that the life of the back blocks is unknown to many urban Australians, who are apt to treat the pathetically true stories of our authors as but tales to while away the time while the billy boils. I have many a time while among these winners of the wilderness, let my fancy roam back to the Shetlands, and the Hebrides (not of our south), where also the women work too hard—and compared them with those around me, and felt the lots of the latter were indeed hard, even though, knowing nought else, they never thought of repining or realized they were in very truth heroines. Life on the land is life indeed to the man—to the woman, the life giver, it is—what I have shown it to be.

Make the woman's lot easier; make it more womanly, and the birth-rate will be favourably influenced. There is but one way to do this, abhorrent as the means is to the Australian democratic idealist. Australia's future depends upon the possession of abundant and inexpensive labour. Her practice already stultifies her theory, for the small settler gets his labour without any wage at all; he depends upon his unpaid wife and little ones.

But, if I am asked whether even this will put Australia into a desirable condition of natural increase, I fear the answer cannot be given with that assurance which the more pronounced advocates of a White Australia take for granted. There is not the vaguest evidence that Australia possesses a single peculiarity that exempts it from the operation of the great though unexplained law which has so invariably pronounced the fiat, thus far shalt thou go and no further. From the earliest prehistoric times of which we have sufficient knowledge—many thousands of years—races have, by conquest and by immigration, striven to enlarge their borders. For awhile, for a few centuries, they succeed; they even, at first, increase and multiply at an abnormal rate, but sooner or later the law of the soil takes effect, partial and then total sterility ensue, and finally the autochthones come to their own again. Races do not fuse in the sense we once imagined they did. There are no permanent half-castes; and since the researches of Mendel we know the reason why.

Nor is it altogether the advantage in competition which the man of the soil has over the new-comer which determines the issue. Extermination of the native does not give the immigrant enhanced powers of increase. The redskin is rarer in the New England States of America than the blackskin is in the New England of the State of New South Wales. Yet, alas that it should be so, the blood of the Pilgrim Father and the Covenanter is as scarce in the land of his adoption as is the blood of the dusky brave whom he swept out of existence.

Annotations.

The Determination of Phenolsulphonephthalein in the Urine in Jaundice (H. A. Abramson, *Arch. Internal Medicine*, Nov., 1924).—The indiscriminate use of alcoholic zinc acetate or saturated barium hydroxid to remove bile pigments from urine containing phenolsulphonephthalein in jaundice may give erroneous readings, because of absorption of the dye. A relatively more accurate method using saturated barium hydroxid as precipitant is described, in which the loss of dye by absorption may be estimated.

Tryparsamide in the Treatment of Neurosyphilis (U. J. Wile and L. M. Wieder, *Jour. Amer. Med. Assoc.*, December 6, 1924).—Tryparsamide has shown itself, during a brief period of observation, of great service in causing a profound change for clinical betterment in a certain group of cerebrospinal syphilis cases, notably in some cases of general paralysis. The type of case found most favourably influenced has, singularly, been the type in which a considerable degree of deterioration had apparently occurred. The most striking clinical changes noted have been increase in weight, colour, and general appearance. In nine cases a marked improvement of the mental state of the patient has been found coincident with the improvement in the general appearance. In five cases, the treatment by tryparsamide was followed by clinical improvement when other forms of therapy, including intraspinal treatment, had failed. This clinical betterment is not paralleled in these cases by striking corresponding changes for the better in the spinal fluid. For this reason, it is possible that the improvement characterized by gain in weight and general appearance may be due partly to the effect of

the drug on syphilitic foci outside the nervous system, as well as to the tonic effect of the arsenic content of the drug. Gastric crises and the lightning pains of tabes dorsalis have, as yet, not yielded to tryparsamide treatment in this series.

Results Secured by Standard Methods of Treatment in Neurosyphilis. Review of 405 Cases (J. H. Stokes and L. W. Shaffer, *Jour. Amer. Med. Assoc.*, December 6, 1924).—In certain types of neurosyphilis the patient's prospect for clinical and serological recovery persisting for a period of years, with restoration to physical well-being and social efficiency, is good. Such results can be secured by the energetic and persistent application of methods of treatment and serologic control already familiar and available to well-equipped general practitioners as well as experts. The intravenous use of arsphenamin (not neoarsphenamin), the simultaneous administration of a soluble mercurial salt intramuscularly, and sodium iodide intravenously, with the use during rest periods of inunctions and, in resistant cases, of intraspinal Swift-Ellis treatment (Ogilvie modification) have been the mainstay of the various methods by which those results have been obtained.

Reinfection in Syphilis. Report of Thirteen Cases (J. Russell Driver, *Jour. Amer. Med. Assoc.*, November 29, 1924).—The thirteen cases of syphilitic reinfection reported satisfy quite closely the requirements laid down to constitute a true infection. A diagnosis was made in twelve of these cases, and treatment started at extremes of from three to twelve weeks, with a median of six and one-half weeks after exposure. Only one old syphilitic patient was treated. In his case, treatment was instituted seven years after infection. These patients, on an average, received from six to twenty-four injections, and from fifteen to fifty mercuric salicylate injections, with a median of twenty-five injections, in order to render them bacteriologically free from spirochætes and in a position to get a new syphilitic infection. No hard and fast rule is laid down as to the amount of treatment necessary to cure a case of syphilis. Each case is one unto itself, but in this series of early-diagnosed syphilitic cases, the foregoing treatment was apparently sufficient. The period of time that intervened between the first and second infection varied from one month to 120 months, with a median of fifteen months. It is believed that this indicates that the first syphilitic infection confers no immunity on its host for any period afterwards. As soon as he is free from the first infection he is open to another one if exposed. From reports of others and this series, it is evident that the curability of syphilis is definitely possible, provided: (*a*) an early diagnosis can be made by the dark-field, and (*b*) early, vigorous treatment can be instituted with arsphenamin and mercury injections. With modern therapy, syphilitic reinfection is probably more frequent than is suspected, and if more patients with syphilis could be closely followed over a period of years, such would be found to be the case.

Report of an Epidemic of Paratyphoid Fever in Patrons of a Cafeteria (E. M. Wade and Orianna McDaniel, *Jour. Amer. Med. Assoc.*, November 1, 1924).—Of 106 cases of paratyphoid fever occurring largely among university students (University of Minnesota) 103 were patrons and employees of a cafeteria. The three remaining cases were in university students who stated that they had not eaten at the cafeteria and had not come in contact with known cases. Four cafeteria employees, of whom two had no symptoms and two were but mildly ill, were found to be carrying paratyphoid bacilli. Evidence was presented indicating probable infection of still other cafeteria patrons and employees. Evidence pointed to pasteurized milk, sold in bulk, as the vehicle of infection, the probability being that the milk was infected after delivery to the cafeteria. The impossibility of fixing on any one individual among the food handlers as "the carrier" responsible for infecting the milk was brought out. Evidence was presented indicating a probable increased prevalence of paratyphoid fever in Minneapolis, synchronous with this outbreak but not directly related to it. Bacteriologic investigation of a small number of rodents and rodent viruses failed to indicate that rodent viruses are a factor in the occurrence of paratyphoid fever.

Incidence of Spirochæta Pallida *in Cerebrospinal Fluid During Early Stage of Syphilis* (A. M. Chesney and J. E. Kemp, *Jour. Amer. Med. Assoc.*, November 29, 1924).—Virulent strains of *S. pallida* have been recovered by rabbit inoculation from the spinal fluids of patients with early syphilis in approximately 15 per cent. of cases when the fluids themselves were normal according to the routine laboratory tests. This is in substantial agreement with the results of other workers who have used the same method.

Syphilitic Aortic Insufficiency (R. W. Scott, *Arch. Internal Medicine*, November, 1924).—A series of twenty-five patients with syphilitic aortic insufficiency was observed clinically, and the diagnosis confirmed by post-mortem examination in every instance. The anatomic changes found in all cases were: (1) syphilitic mesaortitis with extension of the process to the aortic area causing insufficiency at the orifice, and (2) hypertrophy and some degree of dilatation of the heart, chiefly of the left ventricle. One case in four had some grains of coronary occlusion. It was suggested that the progressive widening of the aortic orifice, either from leaflet involvement or ring dilatation, and occlusion of the coronary arteries are the chief factors responsible for the relatively short duration and uninterrupted progression of the heart failure observed in these

patients. The histologic changes in the heart muscle were similar to those frequently seen in hypertrophied hearts from other causes. To attribute these changes to latent myocardial syphilis seems unwarranted by the evidence afforded by this series of cases.

Relations Between Gastric Achylia and Simple and Pernicious Anæmia (K. Faber and H. C. Gram, *Arch. Internal Medicine*, November, 1924).—Gastric achylia is usually found in pernicious anæmia. It is sometimes missing and four such cases are described. In four cases, the histories and examination of which are given, gastric achylia and normal hæmoglobin were demonstrated as long as twelve years before the onset of pernicious anæmia. The results of hæmatologic examination in ninety cases of gastric achylia are described. It is shown that hæmoglobin below normal is present in 41 per cent. of these cases, or in 36·5 per cent. of the sixty-three uncomplicated achylia cases. This anæmia is of the type of simple anæmia and may resemble a chlorosis. It differs from chlorosis by its presence in both sexes and all ages and by its tendency to recur.

Diabetes Mellitus. A Contribution to its Epidemiology Based Chiefly on Mortality Statistics (H. Emerson and Louise D. Larimore, *Arch. Internal Medicine*, November, 1924).—The increase in the incidence and death-rate from diabetes in the United States, and in New York City in particular, has been more rapid than that of any other disease for which we have records in the last fifty years. This increase, while it has affected all ages to some degree, has been most marked among women at all ages and among both men and women over 35 years of age in particular. There are wide variations in the susceptibility to diabetes, or at least to their ability to survive when it develops in them, among persons of different races, those of Semitic stock showing consistently the highest death-rates and those of the Negro race in the United States the lowest. It is not at all clear that these marked differences in the death-rates from diabetes in the people of various races are of fundamental biologic significance, since many elements of occupation, economic status, dietetic habits, &c., may be found sufficient to explain the range of experience with what may fairly be considered a disease of a fatigued function in the great majority of cases. The changes in food habits in the United States have probably contributed to the increase of diabetes, the higher carbohydrate element and greater abundance of superalimentation being believed to be a cause of overfatiguing the function of sugar tolerance.

Two Cases of Melioidosis (A. T. Stanton, W. Fletcher and K. Kanagareyer, *Journal of Hygiene*, December, 1924).—Two cases of fatal melioidosis are described. The first a robust Indian labourer; the second a well-nourished, muscular European. In the first case there were no signs of the disease at first, except enlarged spleen; later, there were signs of consolidation at the bases of both lungs. Constipated at first; diarrhœa came on towards the end, and the patient collapsed and died at the end of the third week. In the second case the illness commenced gradually with pain after food, occasional vomiting and looseness of the bowels. The temperature became high and of the swinging type, accompanied by rigors and sweats. The liver was enlarged. The patient died on the twenty-fifth day. Inoculations were carried out on various animals.

Experimental Production of Pneumococcus Pneumonia in Mice by the Inhalation Method (E. G. Stillman and A. Branch, *Jour. Exper. Med.*, December 1, 1924).—Non-immune mice which are alcoholized and die of septicæmia following exposure to a spray of virulent pneumococci rarely show any localization of infection in the lung. Mice which have been partially immunized by previous inhalations of living or killed pneumococci, and which while alcoholized are exposed to an atmosphere of virulent pneumococci often develop a pneumococcus lobar pneumonia. Mice which have been rendered relatively immune to one type of pneumococcus may frequently develop lobar pneumonia after the inhalation of pneumococci of another type.

The Occurrence of Gastric Lesions in Rats. Their Relation to Dietary Deficiency and Hair Ingestion (A. M. Pappenheimer and L. D. Larimore, *Jour. Exper. Med.*, December 1, 1924).—Ulcerative lesions of the rumen with papillary epithelial hyperplasia occur in a large proportion of rats maintained on a deficient diet, and are rarely, if ever, present when the diet is complete. It has not been possible to ascribe the lesions to lack of any of the known dietary components. The facts that rats on improper diets tend to eat hair, that hair fragments have been found in a number of instances embedded in the ulcers, and surrounded by a definite inflammatory reaction, and finally, that the ulcers have been experimentally produced in rats on a *complete* diet, when chopped hair was added to the food, lead the authors to believe that the ingested hair is an important factor in the causation of the lesions. Whether the hair splinters act merely as mechanical irritants, or as the carriers of an infective agent, has not been determined. It is probable, moreover, that the deficient diets in some way, as yet not understood, intensify the injury caused by the hair. However produced, the lesions are so frequently found that they should be taken into account in experimental work on rats, especially in judging of the effects of dietary influences by the weight curves. That the presence of severe ulcerative lesions in the prostomach must unfavourably affect the general nutrition of an experimental animal, seems beyond question.

Tissue Resistance and the Cause of Permanent Acquired Immunity (S. Nukada and T. Matsuzaki, *Jour. Exper. Med.*, Nov 1, 1924).—The resistance against toxic products of typhoid bacilli of the heart tissues of typhoid-immune animals is greater than that of non-immunized animals. The acquired increase of resisting power is specific. The increased resistance is not caused by antitoxin, but by a specific biological alteration of tissue-cells. It is maintained that permanent acquired immunity, at least in typhoid, instead of being due principally to antibodies, is caused by a lasting specific increase of resisting power acquired by the tissue-cells against the toxic products of bacteria. This theory seems to hold good with other infectious diseases in which one attack conveys permanent immunity.

The Reaction of Pathogenic Fungi to Ultra-Violet Light and the Rôle played by Pigment in this Reaction (A. Pena Chavarria and J. H. Clark, *Amer. Jour. Hygiene*, November, 1924).—X-rays, up to ten skin doses, have a slightly stimulating action on pathogenic fungi of the skin. Visible and near ultra-violet light together are stimulating in moderate doses, but have a slight inhibitory effect in heavy doses on non-pigmented fungi. Non-pigmented fungi may be sensitized by eosin, and probably by other well-known sensitizing dyes, so that they are readily killed by visible light. This reaction takes place *in vivo* as well as *in vitro*, so that it may be of clinical importance. For ultra-violet light has a strong lethal action on non-pigmented fungi. When a fungus, such as *Montoyela*, develops pigment under ultra-violet light a very long exposure is necessary to produce lethal action. Sun-lethal doses in this, and presumably in all species, result in stimulation, provided the doses are short enough. Therefore it is suggested that the function of pigment in fungi, and in the human skin as well, is to regulate the energy absorbed by the underlying cells so that they receive only a sublethal stimulating dose. Pigmentation is therefore a defensive mechanism which favours stimulation and prevents lethal action.

On the Occurrence of Cell-Inclusions in the Rabbit Cornea After Inoculation with the Vesicular Contents and Naso-Pharyngeal Secretion of Varicella Cases (C. E. Simon and J. M. Scott, *Amer. Jour. Hygiene*, November, 1924).—Inasmuch as Bertarelli bodies and Swellengrebel bodies may be encountered in the normal, non-inoculated and non-scarified rabbit cornea, neither can be regarded as specific of varicella, and neither can hence be utilized as a criterion of infection with the hypothetical virus of that disease. The bodies in question are evidently not inclusions of the first order in the sense of the chlamydozoal doctrine. The absence in the varicellated cornea of cell inclusions, corresponding to the zoster bodies of Lipschutz, might on first consideration be viewed as arguing against a supposed causative connection between herpes zoster and varicella, were it not for the fact that Lipschutz could only exceptionally obtain a reaction on the part of the rabbit cornea to inoculation with vesicular fluid from zoster cases. The authors are of the opinion that so far as the development of inclusion bodies is concerned, the rabbit cornea is not a suitable test object in searching for the causative agent of varicella.

The Chemotherapy of Sulpharsphenamin. Toxicity and Trypanocidal Efficiency (G. W. Raiziss, M. Severac and J. Moetsch, *Jour. Amer. Assoc.*, November 29, 1924).—Whether the drugs studied in this paper are evaluated on the basis of the absolute weight of their respective minimum effective dose or on that of their arsenic content, it is found that much more sulpharsphenamin (or the corresponding French product, sulfarsenol) is required to sterilize animals infected with *Trypanosoma equiperdum*, than arsphenamin or neoarsphenamin. In the same series of experiments, it required about 18 mg. of sulpharsphenamin per kilogram to produce the results obtained with, approximately, 4 mg. of arsphenamin or 6 mg. of neo-arsphenamin. Taking the chemotherapeutic $\frac{\text{Maximum tolerated dose}}{\text{Minimum effective dose}}$ index, as the criterion of therapeutic efficiency, sulpharsphenamin based on trypanocidal tests is considerably inferior to arsphenamin, and at most one half as efficient as neo-arsphenamin. The trypanocidal efficiency of sulpharsphenamin is practically the same, whether administered intramuscularly or intravenously.

Studies Based on a Malignant Tumour of the Rabbit. VI. Variations in Growth and Malignancy of Transplanted Tumours. Part I. Results of Transplantation for the First Twenty Generations (H. Wade Brown, Louis Pearce, and Chester M. Van Allen, *Journal of Experimental Medicine*, November 1, 1924).—The results of transplantation, as recorded in the first section of the paper, are analysed from the standpoint of the influence of the factors of serial passage, the material used for inoculation, the age and breed of the animals, and the time or season at which the experiments were carried out. The material used for the inoculation of different groups of animals appeared to have comparatively little effect on the ultimate results. The character of the animals used was found to be a factor of more importance in that the tumour displayed definite peculiarities of growth and malignancy referable to age and to breed or colour markings. Still it seemed unlikely that any of these factors would account for the variations in growth and malignancy that had been observed. After considering the various possibilities presented, it appeared that the principal factors concerned in determining the results of transplantation were adaptation to passage and variations in the conditions of season and weather that prevailed during the time the experiments were being carried out, the one affecting the energy of cell growth and the other affecting animal economy.

Original Communications.

THE IMMUNOLOGICAL RELATIONSHIPS OF THE LEPTOSPIRA GROUP OF SPIROCHÆTES.[1]

By TELÉMACO BATTISTINI, M.D.

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NOGUCHI, in his study of the immunological relation between *Leptospira icteroides*, of yellow fever, and *L. ictero-hæmorrhagiæ*, of infectious jaundice [1], carried out agglutination, complement-fixation, and Pfeiffer reactions with the sera of experimentally-infected animals and demonstrated that these organisms are serologically distinct. Tests of the protective properties of monovalent, as well as polyvalent, anti-*icteroides* and anti-*ictero-hæmorrhagiæ* immune sera always showed the immunological identity of each of the two species. The results of parallel Pfeiffer tests of the sera of convalescents from yellow fever against *L. icteroides* and *L. ictero-hæmorrhagiæ* have shown a specific immunological reaction of such sera to *L. icteroides* but none to *L. ictero-hæmorrhagiæ* [2] Pérez Grovas [3], in Vera Cruz and others in later epidemics [2, 4, 5] confirmed Noguchi's results.

Noguchi has recently studied the serological relationship between the different species of leishmania [6] and found that the type of growth obtained on culture media into which monovalent immune sera had been incorporated furnished a simple and precise method of differentiation of species. This procedure, which is similar to that used by Oba [7] in testing the effect of immune sera *in vitro* upon *L. ictero-hæmorrhagiæ*, has been applied to the study of the three types of *Leptospira* now recognized, *L. icteroides*, *L. ictero-hæmorrhagiæ*, and *L. hebdomadis*[2] (seven-day fever), with the results here reported.

[1] Work done under the auspices of the International Health Board of the Rockefeller Foundation.

[2] The culture of *L. hebdomadis* Strain B was obtained through the kindness of Professor Inada.

TECHNIQUE.

Monovalent sera specific for *L. icteroides*, *L. ictero-hæmorrhagiæ*, and *L. hebdomadis* were prepared in rabbits by intravenous injections at intervals of five to six days, of gradually increasing doses (0·5, 0·1, 1·5, 2·0, and 2·0 c.c.) of actively growing cultures two to three weeks old. The animals were bled by heart puncture eight days after the last injection. The sera were kept in the ice-box until the time of use, no preservatives being used.

The sera were mixed with the culture medium[1] in concentrations of 1:20 and 1:100, and the sera-containing media were distributed into small test-tubes in quantities of 2 c.c. The two dilutions of a given monovalent serum were tested against each of the three types of *Leptospira*, a capillary drop of a young, actively growing culture being inoculated in each instance. The tubes were incubated at 26°C., and examinations were made by dark-field microscope at intervals of 48, 72, 96, and 120 hours after inoculation.

Culture	Anti-*icteroides* sera						Anti-*ictero-hæmorrhagiæ* serum		Anti-*hebdomadis* serum		Control with normal rabbit serum
	Le Blanc		Vera Cruz		Braz. Str. 3		Am. Str. 2		Hebd. Str. B		
	1-20	1-100	1-20	1-100	1-20	1 100	1-20	1-100	1-20	1-100	
Strain of *L. icteroides*—											
Guayaquil Str. 1	−	−	−	−	−	−	+	+	+	+	+
Le Blanc	−	−	−	−	−	−	+	+	+	+	+
Peruvian Str. 2	−	−	−	−	−	−	+	+	+	+	+
Vera Cruz Str.	−	−	−	−	−	−	+	+	+	+	+
Brazilian Str. 3	−	−	−	−	−	−	+	+	+	+	+
Strain of *L. ictero-hæmorrhagiæ*—											
American Str. 2	+	+	+	+	+	+	−	−	+	+	+
Guayaquil Str. No. 30	+	+	+	+	+	+	−	−	+	+	+
L. C. Str.	+	+	+	+	+	+	−	−	+	+	+
Strain of *L. hebdomadis*—											
Hebdomadis Str. B.	+	+	+	+	+	+	+	+	−	−	+

\+ = Active growth, as usual.
− = Marked agglutination and degeneration followed by death of the organisms within 120 hours.

TABLE.

As the table shows, the three monovalent anti-*icteroides* sera tested against five strains of *L. icteroides* produced on the first day marked agglutination and degeneration, followed within four to five days by complete fragmentation of the organisms. On the other hand, these sera had no effect upon the three strains of *L. ictero-hæmorrhagiæ* nor upon the strains of *L. hebdomadis*, all of which grew luxuriantly in the media containing the anti-*icteroides* sera. Conversely, the anti-*ictero-hæmorrhagiæ* serum, while producing agglutination, degeneration and final destruction of all the strains of *L. ictero-hæmorrhagiæ* within three to four days, had no influence upon the growth of *L. icteroides* or *L. hebdomadis*. The anti-*hebdomadis* serum had a similar agglutinating and degenerating effect upon

[1] The formula for Noguchi's *Leptospira* medium is as follows:—

NaCl, 0·9 per cent.	800 parts
2 per cent. nutrient agar, pH 7·4	100 ,,
Rabbit serum	100 ,,
Rabbit hæmoglobin	10-20 ,,

The hæmoglobin solution is prepared by taking 1 part of rabbit blood with 3 parts of distilled water.

the *hebdomadis* strain, but none at all upon the strains of *L. icteroides* and *L. ictero-hæmorrhagiæ*.

SUMMARY.

The immunological properties of the three known species of *Leptospira* have been studied by cultivating the organisms on media containing monovalent homologous and heterologous immune sera. This method of studying the effect of immune sera permits continuous observation over as long a period as desired and thus diminishes the possibility of misinterpretation resulting from gross observations or a single microscopic examination. It also reduces the chance of possible error due to changes which may occur on standing in mixtures of culture with serum alone.

The results obtained constitute additional evidence of the serological distinctions existing among the three species of *Leptospira*, *L. icteroides*, *L. ictero-hæmorrhagiæ* and *L. hebdomadis*.

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TROPICAL OTO-LARYNGOLOGY WITH SPECIAL REFERENCE TO THE PHILIPPINE ISLANDS.[1]

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AND
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THE influence of tropical climate on the causation of disease, the social characteristics of the people, their customs and habits, the influence of heredity, lack of sanitation and many other factors which are not yet fully understood have united together to stamp medical practice in the tropics with peculiar characteristics. The consideration of these factors has resulted in the study of the so-called tropical medicine. In surgery, although the general principles of pathology, therapeutics and operative technique are applicable everywhere, McDill, in his book, entitled "Tropical Surgery and Diseases of the Far East," very well says when referring to the practice in these islands: "The diagnosis and treatment, at their best, require not only a far greater application and correlation of laboratory findings and bedside observations than in our climes, but all of the general and physical conditions of these people must be appreciated and taken into consideration just as well." He continues: "The fish and vegetable diet, non-indulgence in alcohol and the placid existence led by the majority of the natives are to their advantage. They take anæsthetics quietly and react favourably after severe operations."

Another branch of medicine which in the tropics acquires distinct peculiarities is ophthalmology. Elliot, in his great work on "Tropical Ophthalmology," shows how the tropical climate with the almost suffocating heat of the dry season, the heated winds overladen with dust, and the glare of the tropical sun, have a direct influence in the causation of eye diseases. Thus he describes what he terms glare asthenopia and glare conjunctivitis as that group of troublesome symptoms not infrequently found in patients who have for a long period been exposed to the tropical glare. This is but one of the many instances he described in his book. Other factors he mentions as influencing the high incidence of eye diseases in the tropics are the habits and customs of the people with their unqualified practitioners and their primitive and often dangerous methods of treatment and their distrust of the Western methods, and the prevalence of such general diseases as malaria, dysentery, beriberi and others which have eye manifestations. On the whole, the value of that book on tropical ophthalmology lies in the fact that in it the author gives the vast experience (slow-won and often painful, he says) he acquired in India, in a clear, systematic and scientific way. In it he has incorporated also such useful knowledge gathered from the vast and disordered heaps of publications of tropical investigators, abstracted, classified and commented.

Just as all these factors present in the tropics influence the practice of medicine, surgery and ophthalmology, so they do influence oto-laryngology. While reading McDill's "Tropical Surgery," we came across this statement, referring to the practice in the Philippines: "Nothing unusual was noted in the diseases of the eye, ear, nose and throat." (The author was formerly the head of the Department of Surgery of the Philippine General Hospital.) Our observations, however, differ from his. In the literature we find much that has been written about certain ear, nose and throat lesions, especially in connection with such general diseases as entail an involvement of these organs. However, much of these do not go beyond a mere mention of the lesions without such detailed description of them as would be enough to satisfy the need of those that have limited their practice to this speciality. Those writers are not to be blamed for this, inasmuch as the majority are general practitioners whose chief interest is in the general manifestation of the disease. Those who, therefore, practise oto-laryngology in the tropics are the ones called on to develop

[1] Read before the joint annual meeting of the Philippine Islands Medical Association and the Manila Medical Society, December 19, 1924.

this branch of medicine to meet the need which is making itself felt. Their co-operation with the general practitioners will then be of great value, and real scientific work can be accomplished. Medical progress demands the development of this subject, but it will probably take another master mind like that of Elliot to blaze the trail for us in this new and fascinating field of medicine—tropical oto-laryngology

The science of oto-laryngology itself is of recent birth. In Europe and in America, however, it has had such rapid and tremendous progress in spite of its young age, because eminent investigators have entered the field and applied the latest methods of investigation adopted by modern medicine. Otologists, for instance, have invaded even the realm of brain surgery in the study of internal ear diseases; rhinologists, that of the base of the skull to find the easiest way of reaching tumours of the hypophysis; the laryngologists have invented delicate and wonderful instruments and apparatus for the removal of tumour and foreign body in the œsophagus and bronchus. The valuable help of the X-ray has often been resorted to in the correlation of pathological lesions with their clinical manifestations.

Conditions in the tropics, however, are in many respects different. One who has studied and practised abroad and accustomed to such highly scientific atmosphere, on coming here will encounter different problems. He will see the field almost unexplored, and will notice that other influences are at work which make the practice here different from that of his colleague in the West. Elliot very well says that " the surgeon who has become accustomed to the nature of his surroundings in a tropical country learns to accept as a matter of his every-day life things which arrest the attention of visitors from more civilized parts of the world. He is awakened to the privileges of his position by the extraordinary interest such travellers take in what to him have become the routine happenings of an exiled existence." Indeed, when one of the famous oto-laryngologists of America has visited us, his curiosity and interest in tropical ear, nose and throat diseases have made us realize the probable importance of some of our observations of the cases we meet here.

In our present work we, therefore, have attempted to present as best we could what little we have acquired and gained in the way of personal experience in the Philippine General Hospital during the brief period of six years. Most of our observations have been made in the free dispensary or out-patient service of the hospital, where a vast amount of material is available for research work, but a great deal of which, we are sorry to say, is only pitifully wasted. The patients that flock to the dispensary for treatment come from practically all parts of the islands, although the great majority are from Manila and the neighbouring provinces. The average yearly attendance in the department of eye, ear, nose and throat of the free dispensary is about 9,000; of these, about 6,000 are ear, nose and throat cases. In a survey of dispensary cases published by the senior author of this paper in the *Journal of the Philippine Islands Medical Association*, vol. ii, No. 3, 1922, and from a table of diseases of the last six years which we include in this report, we can obtain an idea of the most common diseases found here and their relative frequency, the low incidence of some and the prevalence of others. To what can we ascribe, for instance, the high incidence of acute rhinitis and tonsillitis which come with almost unfailing regularity during certain parts of the year, the so many cases of middle-ear suppuration, especially among children of the poorer class, the large number of furunculosis of the ear, the relative frequency of atrophic rhinitis in young girls and women who lead a sedentary life, and the comparatively few cases of septal deviations? To answer these and many other questions we have to turn our attention to the probable influence which our climate, the education, social condition, habits and customs of the people, and certain anatomical peculiarities may exert. We will now attempt to discuss briefly each of these conditions.

The Climate.

In the study of Philippine climate, certain geographical features must be considered, for these are mainly responsible for the variation in the temperature, and the amount and distribution of rainfall. These are the comparatively great extent of the archipelago from north to south, the numerous islands which compose it, and the fact that the mountains usually traverse the larger islands in a north to south direction. Regarding the temperature, it may be stated in a general way that the range increases with latitude and altitude, the increase being proportionately greater with regard to the latter. At Davao, the annual range is about 4° F., at Manila about 6° F., and in Batan Islands 12° F. Those places at sea level have about the same average mean temperature. In Manila, for instance, it is 80° F. The highest record in this city being 100·9° F. At Baguio, however, having an elevation of about 4,970 ft., the average mean is 64·6° F., the lowest record being 37·4° F. The usual average temperature in Manila for the month of May is 83°F., and for the month of January 77° F.

As regards rainfall, the variation in regions east and west of mountain ranges is very great, although the intervening distance is sometimes only a few kilometres. Distance from a mountain mass, together with the direction of winds also greatly influence rainfall. There are three seasons of rainfall in the Philippines.

(*a*) The typhoon season—from June through October, also known as " rainy season " on account of heavy rainfall. South-westerly winds are frequent, as also thunderstorms.

(*b*) North-east monsoon season—from November through February, the winds from north, north-east, or east, and heavily laden with moisture. Because of the mountain range, the moisture is usually deposited upon eastern shores of the Philippines.

and thus the regions facing China Sea have at this time " dry season."

(c) Thunderstorm season—comprising March, April and May. Rainfall is very irregular.

Because of the different amount of rainfall received by different localities in the Philippines during these three seasons, the archipelago may be divided into three regions of rainfall.

(1) Regions of defined wet and dry season. Rainfall occurring during the typhoon season. These regions have five rainy months and seven dry months. Manila is included in this region.

(2) Regions of long rainy and short dry season.

(3) Regions of continuous rainfall, i.e., with fairly even distribution of rainfall over the entire year.

Now, in the discharge of their respiratory functions the nasal passages are constantly exposed to these ever-changing atmospheric conditions of heat and cold, dryness and moisture. The excessive heat during the months of March, April and May in Manila, and the rather abrupt changes of temperature during the transition of one season to another as caused, for instance, by increased humidity of the air after unexpected rain, producing sudden chilling of the body, have greatly been responsible for the high incidence of acute inflammation of the upper respiratory passages during those months and towards the end of October and in November. It has been found that " cold " may be induced also by prolonged exposure to sun's rays.

The table given at the end of this paper does not show as it should the many cases of acute rhinitis, simply because people do not usually seek treatment for this condition unless there is complication in throat, ear or Eustachian tubes giving pain or much discomfort. If to the dry and heated winds of the dry season is added the effects of dusts, one can easily understand how much the mucosa of the nose and throat suffers. To have an idea of how much discomfort this means he has but to motor to the provinces during the hot days and judge for himself.

However, certain chronic catarrh of the upper respiratory passages which do not respond to medicinal treatment are favourably influenced by climate. In view of this, it is necessary that oto-larvngologists should study the climate in their locality and in the different popular health resorts in these islands. All catarrhal diseases of the upper respiratory passages are favourably influenced by an atmosphere free from dust. We have seen a few cases of chronic rhinitis which could not be improved with local treatment, recovering after a couple of months stay in Baguio.

Education, Social Condition of the People, Quackery.

The Filipinos have been described by McDill in the following words: " The natives of the Philippine archipelago belong to the Malay race, and while there are very few pure Malays among the leaders, the stock has been improved by the admixture of other blood, especially that of Chinese. They are the most enlightened and vigorous branch of the Malays, have been Christians for centuries and are nearest akin to Europeans in thought and aspirations of any alien race."

The majority of the patients coming to the dispensary, and on whom the main observations here have been made, are however of those who are still influenced by quackery or primitive methods of treatment. Many of them seek treatment only after the " herbolarios " or their household remedies have failed to give relief, and when, as it usually happens, more harm than good has been done. The common practice, for example, of removing a fish bone from the throat with the fingers without giving these even a preliminary wash, or by means of the dirty methods of the " suhi," is not devoid of serious consequences at times. This kind of foreign body in the throat is of common occurrence here because fish is a staple food. (The " suhi," by the way, is a person who was born with breech presentation and is supposed by many ignorant people to possess miraculous power of removing fish bone from the throat. He does this by massaging the neck of the patient and then making him (the patient) gargle water which has been in his own mouth). A case came to us of an old woman who after traumatizing her throat with futile efforts to remove with her fingers a fish bone stuck in the pharyngeal wall, went to a "suhi" who prescribed the miraculous gargle. When she was admitted to the hospital she had severe dysphagia and also dyspnœa due to the presence of a large retropharyngeal abscess. We had a case of an abscess at the vallecula consequent to attempts at removing with dirty fingers a sugar-cane fibre which had stuck there. In another case, the epiglottis was acutely inflamed and infected due to similar procedure. Obscure painful affections in the throat are sometimes treated by the so-called " bantil."

The apparent neglect of some of their ailments and sometimes the distrust of the ignorant in modern methods of treatment are responsible for many very chronic and very advanced conditions of the disease met with. Especially is this so in cases of new growths of the larynx and pharynx, the disease is seen at a stage when any operative interference is no longer of value. We have met with huge-sized nasal polyps causing marked disfigurement, very advanced cases of atrophic rhinitis, and large mastoid abscesses.

However, there are certain household remedies employed for some of these diseases. Thus, for tonsillitis, commonly known to the laity as " sampaga," the infusion of certain leaves is used for gargle.

The heated juice of " suro-suro " instilled into the ear canal is said to give relief in cases of acute pain in the ear as in furunculosis. Ringing in the ear is usually treated by inserting a piece of garlic in the canal. A more extensive communication on this subject will probably be published later.

Influence of Certain Habits and Customs.

The habit of chewing buyo has long definitely been known to be responsible for some cases of

carcinoma of the mouth. The new growth, although starting from the cheek or gum, may involve the tonsils and pharyngeal mucosa. Certain ignorant people have the habit of going to the Chinese barber shop to have the ear cleansed of wax. Here, the Chinese, with a bundle of variedly-shaped sticks and brushes, patiently digs up and removes the wax. The most astounding feature of this procedure is that the Chinese ear cleaner has but one set of instruments for all his clients and sterilization is unknown. The trauma that may be inflicted, plus the dirt, will naturally cause disease. The origin of many cases of furunculosis, otitis externa diffusa, and papillomatous growth formation in the canal has been easily traced to this dirty procedure. Those who cannot afford to pay the Chinese use miscellaneous things—tooth-pick, hair-pin or small bamboo stick. The custom of perforating the ear lobule of female infants by the ignorant midwives for the earring is not infrequently followed by infection of the wound.

Influence of Certain Anatomical Characteristics.

The Filipinos, as a whole, have a small nose with low bridge, the vestibule, more or less, rounded and the septum low. This explains the fewer cases of fracture and deviation of the septum causing annoying symptoms. Our records of operation in the hospital show very few of submucous resection of the septum. Again, the face of the Filipinos is usually broad, the hard palate not so highly arched, and the nose not so narrow as the Caucasian. This is also probably why we see so very few cases of classical adenoid fascies.

Parasites in the Ear, Nose and Throat.

No cases of animal parasites in the ear, nose and throat have been seen, but several cases of otomycosis have been observed. This is usually manifested by itchy sensation in the ear, slight deafness and presence of whitish macerated masses in the canal. This condition, when secondarily infected, gives rise to more severe symptoms. So far, we have failed to observe parasitic disease of the maxillary antrum or tonsil.

Ascariasis is prevalent here and it is not uncommon to see the worm coming out through the nose in children.

Rhino-sporidiosis and rhino-scleroma have not been observed. About four years ago, one of us, in collaboration with Professor Haughwout, then of the Department of Protozoology, College of Medicine, University of the Philippines, examined specimens of nasal polypi removed from patients in the hospital, but no parasites were found.

The Ear, Nose and Throat Involvement in Certain General Diseases.

Another factor which, in the tropics, is responsible for the many ear, nose and throat diseases is the prevalence of those general diseases like leprosy, beriberi, yaws and others which have certain manifestations in these organs.

Leprosy.

Our observations are based on some 400 cases examined at Culion Leper Colony, one of the biggest leprosarium in the world. The pinna is almost always involved in the nodular or mixed type of leprosy, the involvement usually consists of diffuse or nodular infiltration starting in the lobule and helix, causing enlargement of the auricle. The nodule may ulcerate. Later, the condition may be followed by atrophy of the skin, and the pinna then appears very thin and small. Middle and internal ear involvement has not been observed. However, Mercado, in his work entitled "Leprosy in Filipinos and its Treatment" (*Revista Med. y Farm.*, 1914, vol. v, No. 8, August) very clearly states that leprosy causes deafness by extension of infection from the nasal mucosa. In the examination of cases in Culion the above findings of Mercado we did not observe.

Involvement of the Nose.

Externally, one sees the tip of the nose and the ala nasi with nodular or diffuse infiltration in the nodular type. Sometimes this is so extensive in advanced leprosy that the weakened anterior septum gives way to this weight and the result is that breathing may be partially obstructed. Frequent nasal catarrh and later on occasional epistaxis seem to be early complaints of the patients. The complaint of obstruction in nasal breathing is more often due to the engorgement of the turbinal mucosa, and in those advanced cases with atrophic condition in the nose, this may be due to presence of crusts in the cavity. Infiltration or ulceration at the anterior portion of the septum at Kiesselbach's area—is an early and very common sign. A small nodule may even be found at this region. Ulceration leads eventually to perforation of the septum at its anterior part. When small it may produce a whistling sound during expiration. In advanced cases there is produced subsequently a sinking down of the bridge of the nose. Among the 400 consecutive cases examined, 80 cases, or 20 per cent., had perforation. With the changes in the septum there are also changes of atrophy in the turbinals, the cavity becomes cavernous, and thick, hard, dry crusts adhered to the nasal wall. This atrophic rhinitis is striking in that it does not have the very offensive smell and the abundant foul discharge of the ordinary and the syphilitic form of atrophic rhinitis. In speaking about the lesion in the nose Mercado, in his article cited above, states that in all their patients treated in the clinic of San Lazaro Hospital, he observed loss of smell "from the time a pathological sign or lesion makes its appearance in the nose." This observation has not been confirmed by us in our examinations made in Culion. Among the lepers pulmonary tuberculosis is very common. Might not this atrophic condition of the nose with its protective powers destroyed share with other factors in the high incidence of tuberculosis among these patients?

Throat Involvement.

In the throat there were seen seven out of the 400 cases with infiltration and ulceration of the uvula and posterior pillars. In advanced cases we noticed atrophic pharyngitis. In these there was marked diminution of irritability, and patients seldom complained of pain, not excepting those with ulcers in the throat. Our observation is that the throat is affected only in advanced leprosy and usually where there is extensive destruction of the interior of the nose. From ordinary inspection, we have obtained the following findings: from a ward where the cases were advanced, 62 per cent. of the patients had throat and mouth involvement; another ward with moderately advanced cases, 53 per cent.; and in a dispensary clinic where patients were strong, 10 per cent. Hoarseness is not uncommon in advanced cases, but the lesion in the larynx should be carefully differentiated from the tubercular, as many of these patients have also pulmonary tuberculosis. Tracheotomy is once in a while resorted to for the relief of choking due to closure of glottis by leprotic growth.

Yaws.

The tertiary manifestations of this disease in the nose, pharynx and palate have been observed here. They are in the form of ulcerations and infiltrations more or less extensive, with bony destruction at times and much deformity giving rise to what has been termed rhino-pharyngitis mutilans. A preliminary study of this condition has been published by one of us (see Nicholas, "Tertiary Manifestation of Yaws in Nose and Throat," *Journal Philippine Islands Medical Association*, 1924, vol. iv, No. 4).

The pinna may be involved. A case presented to a staff meeting of this hospital by Drs. Guerrero and Sison had one auricle entirely eaten up. The case had been admitted three years before and was mistaken for a new growth; was subjected to radium therapy but did not improve. Later, the patient came back with periostitis of the extremities and diagnosis of yaws was then made and confirmed by X-ray and Wassermann test.

Beriberi.

That beriberi gives rise to laryngeal symptoms in the form of paralysis of the recurrent laryngeal has already been observed. (Please refer to Fernando, "Laryngeal Symptoms in Beriberi," *Philippine Journal of Science*, 1924, vol. xxiv, No. 1.) In this report paralysis of only the left vocal cord was found in all three cases, but recently we had a case admitted to the medical ward with complaint of numbness and marked weakness of the legs. Two weeks after onset of the disease the patient developed hoarseness to the extreme of reducing the voice to a whisper. Upon examination there was found paralysis of the left vocal cord and paresis of the right. We consider this as a clinical proof that the paralysis of the nerve is not due to pressure on the nerve but rather to a neuritis. As beriberi is prevalent here notice should be taken of this symptom so that it may be correctly diagnosed.

Small-pox.

This disease may leave extensive scar formation in or around the nasal orifice producing partial or complete atresia. Plastic operation may be necessary to establish normal respiration.

Hay Fever.

Before concluding, a short remark may be necessary regarding this disease. Do we have hay fever in the Philippines? So far, we have not observed a typical case. There is a form of spasmodic rhinitis, resembling hay fever and characterized by frequent and violent sneezing early in the morning, followed by a clear watery flow. Late in the night the patient begins to complain of nasal obstruction, usually more on the side lain on, like the intumescent rhinitis, but during the day he feels perfectly well.

Conclusion.

The foregoing observations represent our experience over a period of six years' work in the Free Dispensary of the Philippine General Hospital, where the majority of the patients attending are of the poor and ignorant class.

The authors of this paper, more than anybody else, are aware of the incompleteness of this work, the omissions in it, and its shortcomings. No pretence is made to cover exhaustively the subject, for we know that it is beyond our reach. We welcome all criticisms as well as every help, for should we have the chance we intend to carry out further this preliminary study, including at the same time an account of the little experience we have gained regarding certain special treatment to suit tropical conditions, and thus we may perhaps be able to present a work worthy of your consideration.

Table of Diseases of the Ear, Nose and Throat

showing roughly the average number of cases per year as compiled from the records of the Eye, Ear, Nose and Throat Dispensary of the Philippine General Hospital from 1918 to 1923 inclusive. These do not include all the cases treated.

Diseases of the Ear.

Diseases	Average per year from 1918-1923 inclusive
Abscess, mastoid	11
Cerumen, impacted	24
Catarrh of Eustachian tube	23
Foreign body	18
Furunculosis	189
Hæmatoma, pinna	16
Mastoiditis	11
Myringitis	64
Otitis externa	75
Otitis media suppurativa	417
Otitis media catarrhalis	80
Oto-sclerosis and dry otitis media	32
Polyp, aural	8
Papilloma, ear	5

Diseases of the Nose.

Diseases	Average per year from 1918-1923 inclusive
Abscess, septum	7
Empyema, maxillary antrum	35
Ethmoiditis (without polyp)	7
Foreign body	30
Polyps, nasal	62
Rhinitis, acute	79
,, subacute	31
,, chronic	176
,, atrophic	131
,, chronic hypertrophic and chronic intumescent	241
,, suppurative	8
,, ulcerative	11
Perforation, septum	12
Ulcerations and submucous infiltration of septum	40
Carcinoma, nose	5
New growths, antrum, maxillary (carcinoma)	2
Furuncle, vestibule	50

Diseases of the Throat.

Abscess, peritonsillar	21
Adenoids (alone)	36
Foreign body	15
Laryngitis, acute	24
,, chronic	27
,, subacute	7
,, tuberculous	49
New growth, tonsil	3
,, larynx	2
Peritonsillitis	14
Pharyngitis, acute	190
,, subacute	78
,, granular	58
,, chronic	194
,, ulcerative	8
Tonsillitis, acute	63
,, subacute	20
,, acute follicular	63
,, chronic hypertrophic	288
,, ulcerative	8

PROPHYLAXIS IN MALARIA.

By H. A. Spencer, M.R.C.S., L.R.C.P.Lond.

THE question of effective protection against mosquitoes, and infection by them, under all conditions, has recently come into prominence once more in connection with sundry articles on malaria published in your journal about a year ago, inquiries for recommendations there anent having been received from several parts of the Union of South Africa and Rhodesia, particularly regarding the dose of quinine considered to be protective, and whether this method can be accepted as effective.

The only really reliable preventive against infection is, of course, to enclose one's living quarters with mosquito gauze and to insure that it is always in thorough repair; nothing more than is already known regarding fly-doors and mosquito-blinds can be said of this method, but it may interest readers to know that my own house was thus protected fourteen years ago, and that the ordinary dark green (iron) gauze, kept by every general store, then erected is still in thorough repair and looks like remaining effective for some years to come. Objection is sometimes taken to the interference of such blinds with the admission of light, an objection easily removed by painting the gauze white, with the precaution of diluting the white lead very freely with turpentine.

There are those, however, who must leave such protection periodically, whose duties take them into hotbeds of malaria for varying periods during which exposure to infection is inevitable unless some sort of precaution is taken; and the question arises, what reliable prevention can be recommended in such cases?

They are at once narrowed down to two in number, the mosquito net and a prophylactic dose of quinine.

(1) The mosquito net is a flimsy thing and easily torn if not handled with affection, but it may be made thoroughly effective when under canvas in the above circumstances. Under instruction and a certain amount of supervision, native servants may be trusted to handle mosquito nets, to erect and to pack them with every care, and the protection they may afford is such that they are worth taking considerable trouble over.

I am acquainted with one disciple of Sir Ronald Ross who has for some years past periodically visited many of the most malaria-infected parts of the country to study and to treat the disease in its worst and most fatal forms, remaining under canvas for weeks at a time and moving about from place to place with literally hundreds of cases around and close to his tent; this he skilfully lines with mosquito netting, goes in and out with proper attention to details and, he tells me, he has never yet had a touch of malaria, though often the only immune person for many miles around.

I am also acquainted with members of the police force who have been provided with a small, conical mosquito net, which will fold up into a sufficiently small space to be carried in the coat pocket or a saddle-bag when they go forth upon patrol into the low veld; at night this small net has been slung to the branch of a tree or to the beam of a store veranda; it has even been trigged up with sticks and slept under, where neither of these shelters were handy, and has to these members given satisfactory protection against infection. It has to be lowered sufficiently to *tuck in* all around the upper part of the body and care taken not to expose the hands.

From results known to me and observed, I have no hesitation in recommending mosquito netting (in one form or another) as the very best preventive against infection when visiting and remaining for a time in malaria-infested parts of the country. My informant, in the first instance quoted, avowed that he would go anywhere and remain as long as ever it was necessary with his mosquito-net lined tent, and maintain his immunity to infection.

(2) There remains only the prophylactic dose of quinine as a preventive against infection, and with the above experience in view I consider that it will still find a place, but chiefly amongst those who are taken rather by surprise in the matter of a forced exposure and for a short time.

The protective dose of quinine is designed to kill parasites as soon as inoculated into the body by a mosquito, by insuring that a solution of the drug shall be in the circulation during the hours when anophelines are known to seek human blood—at night; and when one remembers how very few

parasites are likely to have been wiped off into the duct of a sebaceous or sweat-gland during the insertion and withdrawal of the mosquito's proboscis—even several times during the night—and how exceedingly vulnerable they would be at that stage of their development, it suggests to one's mind that a very high dilution of the drug would be sufficient and effective for their destruction.

It was with this in view that the medium dose of *5 grains* of quinine (on retiring at night) was recommended, a good many years ago now; numbers of medical men in India and elsewhere, over a number of years, have reported thoroughly satisfactory results with this dose and it has been generally accepted as effective.

Later on a second five-grain dose taken on waking in the morning was recommended as likely to "make quite certain of a thorough clearance," in view of the fact that anophelines are prone to seek human blood particularly in the early part of the night and in the dusk of early morning. This method was much applauded and was also widely reported to give thoroughly satisfactory results.

I have followed both methods indifferently on very numerous occasions when delayed a night, or a few nights, without my net, on the low veld where malaria was prevalent, with perfect freedom from infection for many years; whilst, however, convinced that a single five-grain dose at night is sufficient to give protection, I have been accustomed to give inquirers regarding the dose necessary, the choice of the one-night dose or the two doses night and morning and to let them please themselves how many doses they take.

It happens occasionally no doubt that an individual, seeking safety in a small prophylactic dose of quinine while exposed to infection, already harbours adult parasites in his blood, in his spleen or his bone-marrow, upon which the small daily dose has but an inappreciable effect; so that although he *prevents further infection* he may not prevent an attack of malaria as time goes on, though he probably minimizes or delays it. In view, therefore, of the very numerous instances of protection due to a small prophylactic dose and the extreme rarity of an attack of malaria materializing during or immediately after such prophylaxis, I feel convinced that this is a perfectly reasonable explanation of such exceptions.

I do not think that the question as to whether an individual accustomed to taking quinine becomes inured to the drug and should take a larger dose to secure protection, need be touched upon, in view of so many accustomed to take ten-grain doses during attacks of malaria and who, on occasion, again and again secure protection with only a five-grain dose nightly.

In conclusion, I should like to emphasize once more than *in an immune individual* it is probable that an exceedingly dilute solution of quinine in the blood is all that is necessary to destroy the very early phase of the parasite, from the mosquito's salivary glands, which is wiped off the proboscis into the duct of one of our cutaneous glands when inoculation takes place.

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A WHITE AUSTRALIA: IS IT A POSSIBILITY?

By SYDNEY J. SKERTCHLEY, J.P.

(*Continued from page* 197.)

CHAPTER XIV.

Australia and Canada Compared.

In paragraphs 163-5 I gave reasons for my hope, for it is hardly strong enough to be called a

belief, that in Canada and the adjacent part of the United States, which form the wheat district and has a drainage to the north, we have an area in which the White Race may be able to perpetuate itself. We will now compare and contrast the area with Australia.

(1) Australia (with Tasmania) lies entirely north of latitude forty-three degrees south, so that its climate is essentially warm, temperate and tropical.

Canada lies less entirely north of latitude 49° N., so that its climate is entirely temperate and arctic.

(2) Owing to its latitude Australia has no long snow-bound winter, with short days and long nights. Canada has a long snow-bound winter, with short days and long nights.

(3) Australia has few rivers of any magnitude, and these, for the most part, are often mere successions of water-holes, or even dry for months at a stretch.

Canada is abundantly supplied with large and permanent rivers and lakes.

(4) Australia's climate and physical conditions generally are quite unlike those of the European home of the Fair Whites.

Canada's climate and physical conditions are almost exactly like those of the European home of the Fair Whites.

At first sight everything seems in favour of Canada. But, again, a priori reasoning is misleading. We must deal with fact, not fancy. Now, I know Canada, and I know Australia. I admit my friend the Kanuck is a very splendid specimen of manhood; a lumber-man is a sight to do a city-bred man good, and fill him with envy when he contemplates his own un-Sandowed limbs. But he is not a finer man than his cousin of the south. Once more, let me give a personal experience. I had been away from England for some eighteen years, in America and Asia, and latterly in Australia. Landing in the old country, the first thing that struck me was the smallness of the people. I am myself but 5ft. 7½in., and in Australia always felt becomingly insignificant, but in London I passed very well for an average Briton. Both the cold of Canada and the warmth of Australia give rise to the ideal man, as an animal. Walk about the streets of Sydney or Brisbane for an hour, and you will see more six-footers than in a day's tramp in London streets. A Colonial is every inch as good a man as the Kanuck.

But I must modify this statement. So far as I can judge, it is only true of the first generation of "Australian natives." Their children, and their children's children are by no means to be measured by the fathom. Grandchildren are as yet too young for one to be sure of this, and I have to rely upon observation as to the lowering of stature in the third generation, which is unsatisfactory.

I inquired of Major Sankey, who has had over thirty years' experience of Queensland Volunteers, and whose father's military career dates back to before the State was born, as to the physique of the young men offering for recruits. He unhesitatingly declares that both in stature, chest measurement and general set up, the young Queenslander falls short of his immediate predecessors. Captain L. C. Green, of the Australian Engineers, has not so lengthy an experience, yet he tells me he notices a falling off, especially in chest measurement and general build. Queenslanders are, naturally, rather touchy about this, sometimes illogically so. I remember, after making such a statement in a lecture, one of my audience rose and firmly, but courteously, asked me if I had any evidence to produce. I simply put the question, "How tall is your father?" My friend subsided laughing; he had not recollected that his scalp-lock only reached as high as his father's epaulettes.

However this may be, the main fact stands clearly out that in the first, and, perhaps, the second generation, the native-born Australian shows a decided advance in physique over the average Englishman. This at once does away with the suspicion that the climate of Australia is more detrimental to the Fair White than that of Canada.

The effect of the long, dark winter nights of Canada has, I fully believe, a great influence. But it is upon character, not upon physique, and so is not germane to our inquiry. Still, it must be alluded to in passing. Australia has no such winter of short days and long nights. Our southern coasts are not nearer the Pole than forty degrees latitude, or, say, the equivalent of Southern Italy in Europe or San Francisco in America. The Australian winter is, as a whole, a glorious season, and virtually all the extra tropic lands have frosty nights, and much of them frosty days, too. It is an exhilarating season which lures our youth into the open-air. It is *par excellence* the season of sports. Australian winters, as compared with Canadian, are like the seasons of Hong-kong versus Shanghai. We played cricket in winter in Hong-kong, and in summer in Shanghai, and Shanghai nearly always beat us of Hong-kong: the "model Settlement" usually crowded over the "Fragrant Waters."

The Canadian winter is likewise a time of enjoyment, as I cheerfully and thankfully remember. Whose veins tingle not at the memory of sleigh rides, of ice-boats, of goose-fleshy tobogganing, and wild ski races? But Canada lies all north of forty-nine degrees N.; her winter days are short, her nights are longer; and these long, dark nights, when the hush of snow silences the night-sounds; when curtains are drawn, and the wood-fed stove beams warmth and cosiness—then is the time for study. Australia has no parallel to this, nor compensation. Her bright skies and sparkling air (how it sets one a-tingle after absence) lure our youth into the open air—a good thing, almost the best of

things—but not to be indulged in to the detriment of the intellect. This splendid open-air existence tends to harden the young Australian muscle, but not to strengthen his brain; and I see the salutary effects of the long Canadian winter nights fructifying in enlightened policy, in far-seeing public works. Canada is far ahead of Australia in her political standard. We must, to hold our own, have sound brains as well as sound bodies. I should say from my own observation, but cannot prove my case, that among the middle classes—that is those not tied to manual labour—the average Australian woman, if not better educated than the man, keeps up her education better, and is becoming the man's superior as a thinker. Anyhow, I personally would rather trust some great issues to a plebiscite of Australian women than to the men. Our women do not prove their fitness for legislators by breaking the laws, as do some of the misguided sisterhood at home, who would look down upon an Australian as a mere "Colonial!"

All this is beside the mark, yet it may be forgiven to an Englishman who is Australian by adoption, and is jealous of Australian well-being.

One fundamental difference between Canada and Australia is the splendour of the water system of the one as contrasted with the other. Water-carriage must always outbid land-carriage, and Australia has nothing like the great St. Lawrence route from the Atlantic, by Winnipeg to the head waters of the Saskatchewan, a distance of 4,500 miles. The Murray, it is true, is one of the largest rivers in the world—on the map. It is 3,800 miles long, but, alas, over most of its course it loses more water than it receives, and sometimes does not succeed in reaching the sea. In average seasons it is navigable to Albury, a distance of 1,468 miles from the mouth, but only in small vessels. There are (1908) ninety registered steamers on the river, and about the same number of barges, the largest being about 300 tons. After all, we can only look upon the Murray as a canal of no large dimensions, so far as navigation is concerned.

This is undoubtedly to the detriment of Australia; but not so great as might be supposed. Canada was ironically described by envious Yankees as a few acres of snow round the North Pole. There is a little sting of truth in the tail of this witty exaggeration. The same chill hand that lays the plough idle seals up the Canadian waterways for months and then the land of the maple like the land of the wattle, has to depend upon horse and bullock and steam. The northern Canadian rivers are impracticable from rapids and falls, and even now, along the Nelson River from Winnipeg to Hudson's Bay, an iron road is being laid to carry goods along the shortest route from Manitoba to Manchester.

Summing up, then, we find the balance is pretty evenly held between the two countries. It may lean a little towards Canada in its great waterway, but the difference is not enough for us to decide that Australia is not as fit a home for us as Canada.

The last point we have to settle in this comparison is the effect of climate and physical condition. In these Canada is undoubtedly more home-like than Australia. We have nothing in substitute for the bracing north winds, and it is the north wind that has made us north men what we are. We do not seem capable of enduring too much luxury of climate. Out of the bleak Baltic lands our Gothic forebears swept to the balmy south, and our steel sinews won it all for ourselves; but we could not hold it. Homer's heroes had our own blue eyes and blonde complexion and fair hair. Greece knows them no more, save as visitors. It is the Dark White of Mycenæ that to-day the Fair White King George rules over, but he is not of Dorian but of Danish birth.

Australia is as healthy as any part of the world; it can produce the finest type of white man, and keep him vigorous into ripe old age. But, as all this long inquiry has shown, there is not a particle of proof that on Australian soil a new and virile strain of white men is being reared, who, by natural increase, can hold the land.

I do not say we shall die out. But I emphatically declare we must die out—for we are dying out—unless we can check the fatal decline of our natural increase. We are improving our death-rate; but not our birth-rate, yet it is on this our fate depends.

If, then, I am asked for a categorical reply to the question, "Is a White Australia possible?" I answer, "Not under present conditions." But if we can overcome the tendency to aggregate in towns; if we can improve the conditions of woman's life in the bush; then and then only can a true White Australia arise.

How this latter may be accomplished I have hinted at. I will only point out that it will not be in the direction of small holdings, of one-man farms, that seem the ideal of some of our politicians. France has achieved that end, and France is paying the penalty in a declining birth-rate.

Our Fair White race was born in the rugged north. There is evidence to confirm us in the belief that it is a new race; that it is the child of the glacial period. If so, then as a new race can be born, there is hope that another race may arise in this health-giving, bright southern land. But we must produce it ourselves, out of ourselves. We cannot do this by theoretical legislation, or by restrictive edict. We must first grasp, and then grapple with the deep question of our birth-rate. This is the noblest task an Australian can undertake; it is a difficult one, but our race glories in overcoming difficulties. Some of the ways in which we may set about putting our house in order I have pointed out; if these, and others to be discovered, are put into force, we may yet more than hold our own. We shall be a new race, a new White Race, perhaps not altogether Fair White, but we shall be a strong race born of sunshine and not of the north wind, and we shall be true Britishers.

Annotations.

Treatment of Debab Trypanosomiasis of the Dromedary (E. Sergent, A. Donatien, E. Plantureux and A. Deguillaume, *Arch. de l'Institut Pasteur d'Algerie*, June, 1924).—Several medicaments have been tried in the treatment of this disease of which emetic by intravenous injections has given the best results. Administered intramuscularly in an oil solution the effects are not quite so good. Emetic-atoxyl has also proved efficacious. Atoxyl alone was active, but in doses too near the toxic dose. Novarsenobenzol acts the same as atoxyl but is less toxic. 189, trepol, oxycyanure of mercury, biodide of mercury, salicylate of soda, and quinine were efficacious.

On the Subject of Formol-Gelification in Dromedaries and Bovine Animals (E. Plantereux, *Arch. Institut Pasteur Algerie*, June, 1924).—These experiments were carried out in Algerian dromedaries with debab. Only two out of fourteen apparently healthy animals gave positive reactions. Out of thirteen serums of infected animals eight were gelified. No appreciable difference was observed in the different piroplasmoses. The anaplasmoses gave a more rapid reaction. The number of drops of formol for healthy subjects was two and for those infected one. These results are not sufficient for formol-gelification to be used in the diagnosis of bovine piroplasmosis, but it is valuable in the diagnosis of trypanosomiasis of dromedaries.

The Existence of Equine Infection due to Trypanosoma marocanum on the Borders of Algero-Morocco (E. Sergent and A. Donatien, *Arch. Institut Pasteur Algerie*, June, 1924).—The authors have tried the method of crossed reinoculation of Laveran and Mesnil and have obtained the following results. The identity is shown of trypanosomes of horses of West Morocco and those of horses of East Morocco. It is wise in using this method to assure by successive reinoculations the immunity acquired by a subject against the first virus before inoculating a second virus. According to these inoculations, sheep and goats present successively a period of infection, a period of "premunition" commencing between the sixth and eighteenth month, and a period of true immunity commencing after the second year, the duration of which is as yet unknown.

Mosquito Breeding in Specific Places (W. Rudolfs, *Journal of Parasitology*, December, 1924).—Water samples from three distinct regions (cedar swamp and acid clay pits) were studied for chemical constituents, acidity and alkalinity, and for kind and abundance of microscopic plant and animal life. Breeding occurred in the cedar swamp waters whenever the acid water was stagnant. Acidity as such does not seem to affect mosquito breeding. The chemical composition of these waters does not prevent breeding of certain species, but might determine kind of breeding. Food supply for larvæ, which might be dependent on the chemical composition of the water, seems to be the main cause for breeding. High amounts of toxic aluminium and iron sulphates of the waters from clay pits prevent mosquito breeding. *Culex pipiens* larvæ of all ages lived, pupated and hatched in all waters until the food supply was exhausted, except when relatively large amounts of Al and Fe sulphates were present.

Saponification of Bodies in the United Provinces of Agra and Oudh (R. B. J. P. Modi and D. N. Chatterji, *Indian Journal of Medicine*, September, 1924).—Of twelve cases of saponification which came under the personal observation of J. P. Modi, six cases are described in this paper. Time required for saponification in these cases varied from seven to thirty-five days. It is pointed out that saponification is more common in Lucknow than in Agra, probably due to some climatic variations. The saponified tissues in the last two cases of the series did not show any definite structure under the microscope, except masses of acicular crystals and round bodies consisting, in all probability, of natural fat and soap. Chemically, these substances consisted of a minute quantity of lime soap, free fatty acids, viz.: palmitic and stearic acids, unsaponifiable matter, and the ash containing lime, soda and potash compounds.

Investigations on Pulmonary Plague (Dr. M. Tsurumi, *Office International d'Hygiene Publique*, November, 1924).—Results on observations on the recent epidemic (1920-21) in Manchuria are given in detail. There were over 7,700 victims. Investigations show that the tarbagan is a very probable transmitter of pulmonary plague. The plague of tarbagans precedes human plague. The disease is transmitted direct from one person to another. The plague under observation began in bubonic form (thirty-seven cases); septicæmic form (thirty nine cases) then followed, and the remaining cases were all pulmonary. Pulmonary plague is generally prevalent in winter, but in this epidemic, at Karbin, where the plague was most violent, the majority of cases occurred in April. Experiments on animals also showed that contamination takes place through the sputum, through the intermediary of the air.

Laboratory Findings in an Epidemic of Glandular Fever (Ruth Gilbert and Marion B. Coleman, *Amer. Jour. of Hygiene*, vol. 5, No. 1, January, 1924).—In an epidemic of over 100 cases of glandular fever, a report on sixty-three cases was made with regard to family groups, sex, age, date of onset, symptoms and duration of illness. Thirty-nine of forty-three children in these families, or

90·6 per cent., and fifteen of thirty-two adults, or 46·8 per cent., developed the disease. Blood serum from two convalescents failed to agglutinate *B. melitensis* and *B. tularense*. Cultural examinations were made on throat cultures and one specimen of pus from an axillary gland. *Streptococcus hæmolyticus* was isolated from the pus and from four of the seven throat cultures. *Streptococci* producing methemoglobin were present in all except one of the seven throat cultures. One case of acute myelogenous leukæmia, which occurred in the same county as the epidemic of glandular fever, is reported for purpose of comparison. Blood examinations were made in thirty of the cases. Seven, or 23·3 per cent., showed polynucleosis. An increase in the number of eosinophils was noted in 66 per cent. Twenty-two, or 73·3 per cent., showed an increase in lymphocytes. Thus, a lymphocytosis may be expected in some stage of glandular fever. These observations are on the whole similar to those of earlier workers; they are, however, too meagre to form the basis of any significant conclusions.

The Early Diagnosis of True Hernia of the Diaphragm (D. P. Abbott, *Jour. Amer. Med Assoc.*, December 13, 1924).—Small hernias of the diaphragm, especially periœsophageal, are much more common than is usually supposed. A careful study of the symptomatology should suggest their presence. Routine examination of the patient with the fluoroscope, as described, will reveal small periœsophageal diaphragmatic hernias, which will otherwise be missed. Needless to say, the repair of a small hernia is less difficult than the repair of a large one, and the dangers of complications are less in the former.

Congenital Ectodermal Defect (G. M. MacKee and G. C. Andrews, *Arch. Dermat. and Syph.*, December, 1924).—Eight *bona fide* patients are recorded who presented a fairly universal congenital ectodermal aplasia. They all exhibit the same clinical characteristics, and they comprise a distinct group of congenital ectodermal defect. As there are but ten recorded cases belonging to this group, only eight of which have been described, the affection may be regarded as rare, at least until a larger number of patients are recorded. The principal clinical characteristics of this group are: congenital absence of sweat-glands; absence of pilosebaceous apparatus over most of the body; marked dental aplasia; depressed nasal bridge; atrophic rhinitis; prominent supra-orbital ridges; thick, protrusive lips; thin, glossy, smooth, dry skin; papular lesions on the face; heat intolerance. The detailed description of a new patient is presented, who, in addition to possessing all the clinical characteristics, exhibits: a mongolian facies; deformed ears; fine wrinkles of the eyelids and environs; radiating linear defects at the oral commissures and near the nostrils; aplasia of the nails; narrow lower half of face; unusually large number of papules on th face; absence of atrophic rhinitis. The affectio is familial. All but one patient are males. Mo of the patients and their ancestors appear to h free from syphilis and tuberculosis. Th cause of the developmental defect is unknow Arrest of development occurs very early i intra-uterine life. The absence of sweat glan offers an unusual opportunity to study th physiology of perspiration. Experiments an observations thus far made show that insen sible perspiration is probably independent o the sudoriparous glands; that the principal functio of perspiration is to regulate the body heat; tha the sweat glands constitute an emergency apparat for this purpose; that patients without swea glands are handicapped through inability to radiat sufficient heat under certain environmental con ditions, but they are healthy and active, an longevity is apparently unaffected.

Experimental Acne Varioliformis (M. M. Strumia *Arch. Dermat. and Syph.*, December, 1924).—Tw cases of acute acne varioliformis which were distinc tive by reason of deeply necrotic and hæmorrhagi centres and surrounding woody œdema yielde both staphylococci and streptococci in culture They were also present in the nose and throat i one case. Lesions identical in morphology wit those of acne varioliformis were reproduced in th patient by the intradermic injections of these tw organisms (both autogenous and stock), and com parable ones were repeatedly produced in guinea pigs. It follows from the foregoing that th organisms are not of a strain specific for this di ease, and that a tuberculous factor can be definitel excluded from some cases of acne varioliformis This combination of organism, in yielding so charac teristic a lesion, might be useful in other exper ments having other bearings, such as the genera subject of distribution of lesions. It is possibl that the dusky, necrotic, indolent characters o tuberculosis have been referred to the somewha similar ones of a streptococcus, and that this i responsible for some of the present ideas of th tuberculous nature of acne varioliformis. In the fu unculoid state which is known as acne varioliformis different organisms may be operative. The caus of one type is a staphylococcus and streptococcus neither of which of itself can produce the typica lesion. The deep position of the organism explain the varioliform type of scar. The hæmorrhage necrosis, woody œdema and the slow healing reflec known traits of streptococcus.

Iodine in Exophthalmic Goitre (F. R. Fraser *Brit. Med. Jour.*, January 3, 1925).—The effect o iodine administration has been studied in twenty four cases of exophthalmic goitre. Iodine ca bring about a lowering of basal metabolic rate and of heart rate, and an increase of body weight with a striking improvement in the general con dition of the patient. The improvement obtaine

with iodine does not as a rule persist. The optimum dose at the commencement of the treatment appears to be about 15 minims of a ten per cent. solution in alcohol, but this dosage cannot as a rule be maintained more than a few days or weeks. If the administration is stopped the condition immediately relapses. For prolonged treatment the dosage should be lowered as soon as the initial improvement has taken place, and the administration continued with doses of 3 to 6 minims daily. The dosages must be carefully regulated according to the condition of the patient. Increasing hardness of the thyroid gland is an indication for a smaller dosage. The condition of the patient may be made worse, instead of better, if too large a dosage is employed.

The Action of Buried Glass Capillaries of Radium Emanation on Plant and Animal Tissues. An Experimental and Clinical Study (I. Levin and M. Levine, *Jour. Amer. Med. Assoc.*, November 22, 1924).—The intratumoral insertion of bare capillary glass tubes of radium emanation presents to-day the best single method of radiotherapy in various types of carcinoma and sarcoma, for the following reasons. It allows an even distribution of small quantities of radiations throughout the tumour. On account of the intimate contact of the radio-active substance with the tumour cells, the total amounts are small, and local results are obtained without any general effect on the organism. Use is made of the beta rays, which do not act as a simple caustic agent but destroy the nearest cancer cells and at the same time create secondary gamma or Rontgen rays in the tissues, and by the aid of these influences the cancer cells situated at a greater distance in a manner analogous to the action of the gamma rays of radium and the Rontgen rays. Thus, while it is true that to date the best results in cancer therapy are obtained by proper co-ordination between surgery and all methods of radiotherapy, it is imperative that more experimental work be done on the biologic action of the beta rays of radium.

Clinical Studies on the Kahn Reaction for Syphilis (H. L. Kleim and R. L. Kahn, *Arch. Dermat. Syph.*, December, 1924).—The diagnostic value of the Kahn precipitation test for syphilis was studied in 2,600 cases in comparison with two Wassermann tests—one highly sensitive and one more conservative in character—with the following results: In primary syphilis (twenty-five cases) the Kahn test was found slightly more sensitive than either of the two Wassermann tests. In secondary syphilis (sixty-four cases) there is agreement in the three methods. In tertiary syphilis, excluding cerebrospinal (eighty-seven cases), the Kahn test was found slightly more sensitive than both Wassermann tests, except that in visceral syphilis it compared with the more sensitive Wassermann test. In cerebrospinal syphilis (192 cases), the reactions with the Kahn test fall about mid-way between the highly sensitive and conservative Wassermann tests. In latent syphilis (218 cases), the reactions with the Kahn test compare favourably with the reactions with the long ice-box fixation Wassermann test. In congenital syphilis (thirty-nine cases), the Kahn test is slightly more sensitive than either of the two Wassermann tests. In non-syphilitic controls (1,975 cases), the Kahn test gave two one-plus reactions and two two-plus reactions in dermatologic conditions apparently non-syphilitic.

Studies on Microsporidia Parasitic in Mosquitoes (R. Kudo, *Jour. of Parasitology*, December, 1924).—The development of *Thelohania opacita*, parasitic in *Culex testaceous*, *C. territans*, and *C. sp.* is given. The schizont multiplies by a binary fission. At the end of schizogony, binucleated forms are formed. After the fusion of the nuclei, the sporont is produced. Both octosporous and tetrasporous sporonts occur, which develop into normal and smaller spores and larger and abnormal spores respectively. The small and large spores are similar in structure. The spore membrane is composed of two valves. The microsporidian infection is fatal to the hosts in the cases observed.

Giardia and Chilomastix from Monkeys, Giardia from the Wild Cat, and Balantidium from the Sheep (R. W. Hegner, *Jour. of Parasitology*, December, 1924).—Cysts of giardia are reported for the first time from a monkey; they are more slender than those of *Giardia lamblia* from man and probably represent a new species. Cysts of giardia are also reported for the first time from the wild cat; they are similar in size to those of the monkey. Cysts of a chilomastix are reported for the first time from a monkey; they are significantly larger than those of *Chilomastix mesnili* from man. A balantidium is reported for the first time from sheep.

Alcoholic Injections into the Gasserian Ganglion (G. M. Dorrance, *Jour. Amer. Med. Assoc.*, November, 22, 1924).—Injections of the gasserian ganglion are usually permanent, if enough alcohol is injected. At times one is able to inject the lower one-third or half of the ganglion and not involve the entire ganglion, but no one can promise this. Paralysis of the ocular muscles occurs at times. It always clears up. The absolute indication for injecting the ganglion is in carcinoma of the upper or lower jaw, or on one side of the tongue. In outside injection as well as ganglionic injection, the prognosis can be made at the end of the month, i.e., if anæsthesia is present at the end of the month, it is apt to remain so. The results depend on just how much alcohol is distributed in the ganglion or posterior root, and, in the case of an outside injection, into the nerve fibres. Eye complications occur in about the same proportion as in division of the root by any other method.

Familial Blood Dyscrasias (L. M. Morris and E. H. Falconer, *Arch. Internal Medicine*, December 15, 1924).—The conclusions of this paper are: Before cases are grouped as familial splenomegalies, it is necessary to eliminate certain common sources of infection, syphilis, malaria, and certain of the tropical diseases being most common factors for error. Before cases are grouped as familial anæmias, it is necessary to eliminate certain common toxic and infectious factors, lead, arsenic, syphilis and malaria being common sources of error. Family diseases of the spleen are probably related in many instances to a congenital predisposition of the hæmolytopoietic system. A disposition toward inferiority of the hæmopoietic system probably exists. Detailed family histories are essential to prove this point.

A Case of Sickle Cell Anæmia with Necropsy (G. S. Graham, *Arch. Internal Medicine*, December 15, 1924).—Sickle cell anæmia has been held to constitute a definite disease entity. The present clinical and pathologic study of a well defined case is believed to confirm that view. Characteristic signs and symptoms are readily demonstrable by clinical and laboratory methods, while post-mortem examination reveals interesting lesions, particularly affecting the hæmatopoietic system. The number of cases thus far studied at necropsy is too limited to allow the formulation of any far-reaching conclusions as to the exact nature of the disease. The condition may consist in an underlying status, determined primarily by deeply rooted racial characteristics and brought into clinical evidence in occasional persons through the immediate action of toxic, metabolic or infectious exciting agents. There is a certain amount of evidence favouring the view that this immediate causative factor is bacterial, and particular suspicion is directed toward the streptococcus.

The Pathology of Pneumonia Caused by Bacillus influenzæ during an Inter-Epidemic Period (D. Brannan and E. W. Goodpasture, *Arch. Internal Medicine*, December 15, 1924).—The influenza bacillus may be an important agent in the production of broncho-pneumonia in adults during a period in which there is no evidence of an epidemic of influenza. It usually invades the lung in association with infections by the pneumococcus or other bacteria which were probably the primary agencies of the disease in which the influenza bacilli were found. The influenza bacillus produces characteristic lesions in the lung recognizable grossly and microscopically. The lesion is essentially a bronchitis, ulcerative bronchiolitis, and broncho-pneumonia with a tendency to chronicity and to the formation of bronchiectatic abscesses. Acute infections with an influenza bacillus may not be associated at any stage with a profound toxemia, nor may there be lesions of toxic origin, as were found in the pneumonias of the influenza pandemic of 1918. The influenza bacillus is to be considered as one of the important secondary in vaders of the lung, causing a broncho-pneumoni which may terminate fatally. The hyaline men brane that occurred so characteristically in earl influenzal pneumonia in the past pandemic ha been demonstrated typically in two cases in whic an influenzal infection could have played no par This lesion is probably due to an injury to th pulmonary capillary bed, and its frequency in in fluenza is attributed to a toxic injury to the capi laries of the lung from a circulating poiso generated by the logic agent of this disease.

Experimental Study of Trypanosomiasis i Palestine (I. J. Kligler and I. Weitzman, *Annal of Trop. Med. and Parasitology*, December 3(1924).—An outbreak of trypanosome infection i mules in Northern Palestine afforded an opportunit for an experimental study of trypanosomiasis i lower animals, particularly rabbits and pigs. Th morphology of the parasite, the clinical picture o the disease, and the pathological lesions produced indicate that the strain belonged to the *T. evans* group. The therapeutic effect of "Bayer 205 and the mode of the action of this dru were investigated. The drug proved very effec tive in clearing up the infection in dogs, rab bits and guinea-pigs; a single dose of 0·0 grm. per kilo of body weight was sufficien to sterilize the blood in all instances an apparently affected permanent cure in eighty pe cent. of the rabbits and guinea-pigs so treated The mechanism of the drug is of interest. *In vitro* it has very little trypanocidal power; *in vivo* on the other hand, so small a dose as 0·05 grm per kilo suffices to sterilize the blood of a heavil infected animal in about sixteen hours. Experi mental evidence is advanced in favour of the view that a real immunity or resistance to infection i set up in the body of animals cured from infection This immunity or resistance seems to be associate with the formed elements of the blood. Repeate search failed to reveal any of the usual humora antibodies. On the other hand, profound change occur in the white blood-cell formula during th infection and after the treatment. Moreover, i is possible to break down the resistance artificiall by the injection of olive oil, a substance shown b various authors to modify the white cell ratio

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The Question of Human and Pig Ascaris (F. K Payne, J. E. Ackert and E. Hartman, *Amer Jour. of Hygiene*, January, 1924).—The hos relationship of human and pig ascarids was teste by the administration of embryonated *Ascaris* egg to pigs and primates. Repeated feedings of infecte human *Ascaris* eggs were made to five young pigs all of which suffered respiratory disturbances an other systemic disorders. Subsequent post-morten examinations showed no ascarids in the digestiv tract of any of the pigs. Severe cases of "thumps" occurred in all of the pigs fed upon the eggs o the human *Ascaris*. This appears to be the firs

record of " thumps " caused by the administration of human *Ascaris* to pigs. Infective pig *Ascaris* eggs were taken by one monkey and by two human subjects. Fæcal examinations made throughout periods of several months after the initial administration of eggs failed to show the presence of *Ascaris* eggs. The incidence of *Ascaris* in North, Central and Southern Trinidad, British West Indies, varied from twenty to seventy per cent., for the human *Ascaris*, and from 3·5 to 10·8 per cent., for the pig *Ascaris*. In the vicinity of Arouca, one of the principal swine-raising regions, the incidence of human *Ascaris* was 64·3 per cent.. as compared with QP 1 per cent. of the pig *Ascaris*. The experimental results indicate that embryonated eggs of the human *Ascaris* will not produce mature ascarids in pigs, that infective eggs of the pig *Ascaris* will not produce mature ascarids in the adult primates—monkey and man, and that there is thus a physiological difference between the human and the pig *Ascaris*.

Serological Studies of Experimental Syphilis (Satoshi Takenaka, *Acta Dermatologica*, vol. 4, fasc. 1, September, 1924).—The so-called non-specific positive Wassermann reaction in healthy rabbits, though not absolutely absent, appears only occasionally when proper precaution is taken, and is of a degree which does not interfere with the investigation of the Wassermann reactions of the rabbit. In the author's work the non-specific positive reaction constituted about one per cent. of the entire group of rabbits. The amount of serum for testing the Wassermann reactions is 0·2 c.c. and the antigen suitable for the purpose is the alcoholic extract of the ox heart treated with ether and again with aceton according to Noguchi's method. The primary sclerosis of rabbit syphilis and the Wassermann reactions generally progress in close agreement with each other. The infection or the non-infection of the testis seems to have a great significance in inducing the positive Wassermann reaction. The appearance of the general symptoms, such as keratitis, does not give rise to positive Wassermann. The effect of reinoculation on the Wassermann reaction depends on whether the primary sclerosis is produced or not. According to the antigens used, the degree of positive reaction and the percentage of non-specific reaction differ. In the diseases producing sclerosis in rabbits resembling that of syphilis—due to *Spirochæta cuniculi* or the spirochæta of rat-bite fever —even when the testes are chiefly attacked, the Wassermann is always negative. Judging from these results the Wassermann reactions of rabbit syphilis are considered specific, but they differ greatly from human syphilis in that the Wassermann reaction becomes negative on the disappearance of the primary sclerosis in this animal, and also in that the appearance of the positive reaction depends to some extent upon whether the testis is affected or not.

Current Literature.

Revista Medica de Angola. Special Number of the First Congress of Tropical Medicine in West Africa. Vol. III, 3rd, 4th and 5th Sessions.

The Box-Stove (*La Caisse-Etuve*). *Practical Process of Disinfection by High Steam Pressure of Steam-Engines* (G. Lefrou).—This new device for disinfecting bed-linen, clothes, &c., in cases of pestilential diseases has proved of great value in the Congo, where it is difficult to obtain a proper steam-stove. It consists of a solid wooden case into which the steam is forced by a locomotive engine. The stove is placed on a wagonette with wheels and is thus easily taken from place to place. The stove can hold three mattresses or 100 single-sized bed covers. The temperature inside the stove is kept at about 150°. Fusible tubes placed between the clothes inside, show that this temperature is reached in about twenty minutes. It has been observed that steam at a temperature of 80° or 90° suffices to destroy parasites and their eggs in fifteen minutes. This stove can also be used for other purposes, such as disinfecting linen on liners, in factories, &c.

Intestinal Helminthiasis in the French Colonies. Prophylaxis and Treatment According to Recent Works Published (Ch. Joyeux).—A review of the recent works published on intestinal helminthiasis in the French colonies shows the frequence of ankylostomes, ascarides and of trichocephalus; ankylostomes being the most frequent. The statistics given are principally from the examination of the stools of soldiers, prisoners, inmates of hospitals, &c. It is rather surprising that *Hymenolepis nana* does not figure in the reports, except in Algerian statistics; the parasite is common in the Mediterranean basin and nearly all hot countries. The question as to whether the number of eggs found in the stools corresponds to the number of live worms in the intestine has not yet been satisfactorily answered; opinions on this point differ. Mass treatment is more satisfactory than microscopic examination of fæcal matter. Race has no effect on the disease. One of the most important prophylactic measures to be taken is the disinfection of soils. Three medicants have proved efficacious in the treatment of helminthiasis; thymol, chenopodium oil, and tetrachloride of carbon, but the action of the latter is not equal to that of the other two.

Experiments in the Treatment of Fuso-Spirillary Ulcers in Angola (Frederico Rebelo and Carlos d'Almeida).—The ulcers of Angola belong to two types: Leishmanial ulcers, and fuso-spirillary ulcers. Cases of myasis have also been met with, and other cases of ulcers undoubtedly exist there. The authors give their results of treatment of fuso-spirillary ulcers, some of which were long-

standing lesions. The most efficacious medicaments used were neosalvarsan in intravenous injections; trepol, applied locally; washings with a solution of dakin followed by dressings with gomenol (2 per 1,000). The keroplastic action, besides continual sterilization, has been maintained by injections of "914" and trepol; also by dressings with gomenol.

Contribution to the Therapeutic of Leishmanial Ulcers (Carlos d'Almeida and Frederico Rebelo).—In the treatment of leishmanial ulcers, tartar emetic by intravenous injections has given wonderful results, even in very old cases which would not respond to any other medicament. The emetic can also be used intramuscularly with the same success, but cicatrization is slower. Solution of Bouin used in cases of ulcer proved a good keroplastic; this action has been recently confirmed by a great number of researches.

Note on the Amœbæ observed in Fuso-Spirillary Ulcers of Angola (Froilano de Melo).—It is found that in Angola human intestinal amœbæ, both *histolytica* and *coli*, can invade the ulcerous lesions of the skin, where they find the necessary elements for their nutrition and their development. It is in the fly-excrement on the ulcers that the origin of amœbic infestation is to be found; the flies are extremely abundant in Angola, and constitute a sanitary problem worthy of attention.

Bilharziosis in French West Africa (Marcel Leger).—Vesical bilharziosis has been observed in French West Africa for the past eighteen years, and is still met with very often. Fewer cases of intestinal bilharziosis have been recorded. 159 cases of infestation by trematodes have been observed by the author, 19 intestinal and 140 vesical, in 1922 and 1923. The trematodes harboured by the blacks cause very little morbid trouble. The fæces are generally normal, and the patients do not complain of any intestinal symptoms. Both *Sch. hæmatobium* and *Sch. mansoni* have been found in the intestinal cases. Vesical infestation co-existed in only two of the nineteen cases of intestinal bilharziosis. 139 of the 140 cases of vesical bilharziosis were due to *Sch. hæmatobium*, the other one to *Sch. mansoni*.

Some Considerations on the Treatment of Bilharziosis by Emetic (Carlos Franca).—Emetic, J. B. Christopherson's method, has proved the most efficacious of all the medicants used in the treatment of bilharziosis. An interesting account is given of the ovular changes observed in the examination of the urinary sediment of each patient. In regions where there is no laboratory, the sediment can be preserved in the liquid prescribed by Langeron: formol, 5 c.c.; glycerine, 10 c.c.; distilled water, 100 c.c.

Prophylaxis of Venereal Diseases (Dr. Walravens).—Statistics show that venereal diseases have greatly increased among the population of the colonies, especially in the Belgian Congo, since 1916. A law has been passed by the Belgian Government on the same lines as the law of the Swedish Government, making it obligatory for persons affected to report and receive appropriate treatment; patients can be treated free of charge if they wish.

Syphilis Among the Blacks of Senegal. The Fight Against Syphilis at Dakar (M. Nogue).—Syphilis is widely spread not only among the Senegalese, but also among the people of Sudan, and very often is found in patients under treatment for non-syphilitic diseases. Yaws, on the other hand, is very rare in Senegal. Syphilis in natives is not so benign as generally believed, and is sometimes fatal. It is responsible for a great many cases of abortion, and the debility of a number of children. The association in natives of syphilis, malaria and ankylostomiasis has often been observed. The under-nourishment of the patient and general conditions offer good ground for the development of parasites. A very good account is given of the different stages and different types of the disease.

Considerations on the Epidemiology of Plague. Man can, like the rat, be a reservoir of Virus (Marcel M. Leger).—This paper proves that man is susceptible to become a chronic carrier or healthy carrier of the Yersin bacillus. He constitutes, in the same capacity as the rat, a reservoir of virus, but is more to be feared, as the germ seems to have a lesser tendency to decrease in man than in rat. Anti-plague prophylaxis is therefore necessary not only among animals, but human subjects.

Plague in Angola (A. Damas Mora).—Plague seems to have made its appearance in Loanda in January, 1921. Nearly all the cases were of pure bubonic type. The severity of the cases seemed to depend on the number of bacilli present. Fever was always irregular. Cough was often noted with expectoration, sometimes muco-purulent. In grave cases death generally followed the third or fifth day of illness; death rarely occurred after the fifth day. All the epidemics in Angola have been preceded by a murine epizootic. There has been no evidence of the plague being of human origin.

An Epidemic of Acute Poliomyelitis in the Belgian Congo (J. Rodhain).—The epidemic of poliomyelitis prevalent in the Belgian Congo towards the end of 1919 and beginning of 1920 clinically and experimentally resembled Heine-Medin disease. It was characterized by a mortality of 27 per cent., and by the considerable proportion of the total of adults affected, 23·9 per cent. Without excluding the possibility of an exogenetic origin, it is probable that it resulted from the extension of one of the endemic centres existing in the region of Mayumbienne, Southern Congo. Malaria is not a predisposing condition of poliomyelitis, but human trypanosomiasis, on the contrary, seems to create a special receptivity for Heine-Medin disease.

This volume contains many other very interesting papers on tropical subjects by well known authorities.

Original Communications.

NOTES ON THREE NEW YEAST-LIKE ORGANISMS AND A NEW BACILLUS, WITH REMARKS ON THE CLINICAL CONDITIONS FROM WHICH THEY HAVE BEEN ISOLATED: — FURUNCULOSIS BLASTOMYCETICA, MACROGLOSSIA BLASTOMYCETICA, STOMATITIS CRYPTOCOCCOBACILLARIS.

By ALDO CASTELLANI, C.M.G., M.D., F.R.C.P.

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(1) YEAST-LIKE ORGANISM FROM CASES OF FURUNCULOSIS BLASTOMYCETICA (FURUNCULOSIS CRYPTOCOCCICA, PSEUDO-FURUNCULOSIS BLASTOMYCETICA, FURUNCULOSIS MONILIACA, FOLLICULITIS DECALVANS CRYPTOCOCCICA).

Three years ago I described a peculiar type of blastomycosis indistinguishable clinically from ordinary furunculosis, which I called at the time "Furunculosis cryptococcica," and as the condition in the first two cases principally affected the scalp under the form of a purulent folliculitis and loss of hair I suggested also the term "Folliculitis decalvans cryptococcica" for it. To date I have seen five cases; three contracted the infection in Great Britain and two in India. The strains of fungus isolated from the English cases are all identical; the strains isolated from the Indian cases are somewhat different from the organisms grown from the English cases, and differ also, though slightly, among themselves.

Description of the Organism (English cases).—Morphologically a yeast-like organism, Gram-positive, not acid-fast. The individual cells are somewhat rounded or oval. Maximum diameter of most cells 3 to 4 microns. The fungus is seldom detected microscopically in the pus of the boil-like lesions, staphylococci being generally present in very large numbers; cultural methods are necessary; the cultures from the pus as a rule look like cultures of *Staphylococcus aureus*. It may be necessary to make a dozen or more preparations from what looks a pure staphylococcus growth to find a few yeast-like cells. By plating and replating on glucose agar media the fungus is finally isolated.

Cultural and biochemical characters. — The fungus grows abundantly on *glucose agar* and grows also well, though less abundantly, on ordinary agar. The cultures on glucose agar are at first white, but after a few days show a characteristic yellowish- or yellowish-brownish pigmentation. Gelatine and serum are not liquefied.

Lead agar is not darkened during the first two weeks; later a slight darkening may take place.

Sugar peptone-waters.—The fungus when recently isolated has very little or no fermentative action on any sugar; it may produce a slight acidity in glucose and levulose, very seldom a slight amount of gas. When the fungus has been transplanted several times its fermentative action is greatly increased and it generally produces acid and gas in glucose and levulose and occasionally slight acidity in galactose; it does not form gas in any other sugars (see table I).

Litmus Milk.—The medium is not clotted, a slight acidity may be present.

Agglutination.—The fungus is agglutinated by the patient's blood in certain cases up to 1 in 400.

Ascospores, mycelium.—I have never observed asci even in very old cultures; mycelium in small amount is not rarely present in certain media, especially fluid media.

Classification.—This fungus, consisting of rather large roundish cells, some of which are budding, comes under the general heading "Yeast-like Fungi" or *Blastomyces sensu lato*, of which two large groups may be distinguished:

(*a*) Asci present.
(*b*) Asci absent.

The fungus is yeast-like, but no ascus formations are seen even in very old cultures. It should therefore be placed in the division of yeast-like fungi with no ascospores. This division, or to be more correct, family (Cryptococcaceæ Kützing 1833), contains the genera *Cryptococcus* Kützing 1833, *Torula* Persoon 1801, *Mycoderma* Persoon 1822, *Monilia* Persoon 1797, *Pityrosporum* Sabouraud 1895, which may be differentiated as follows:

(A) MYCELIUM ABSENT:

(i) Vegetative cells, elongated, in fluid media thick membrane, with bubbles of gas—*Mycoderma*.

(ii) Vegetative cells, roundish or oval.

(*a*) *Several buds at a time*, each cell contains large globule of fat, non-pathogenic, no fermentation of sugars, thick membrane with no gas bubbles, often pigment-producing—*Torula*.

(*b*) *Monobudding*, no thick pellicle on fluid sugar media, presence or absence of fermentation—*Cryptococcus*.

(*c*) *Not cultivated*, cells never show a double contour—*Pityrosporum*.

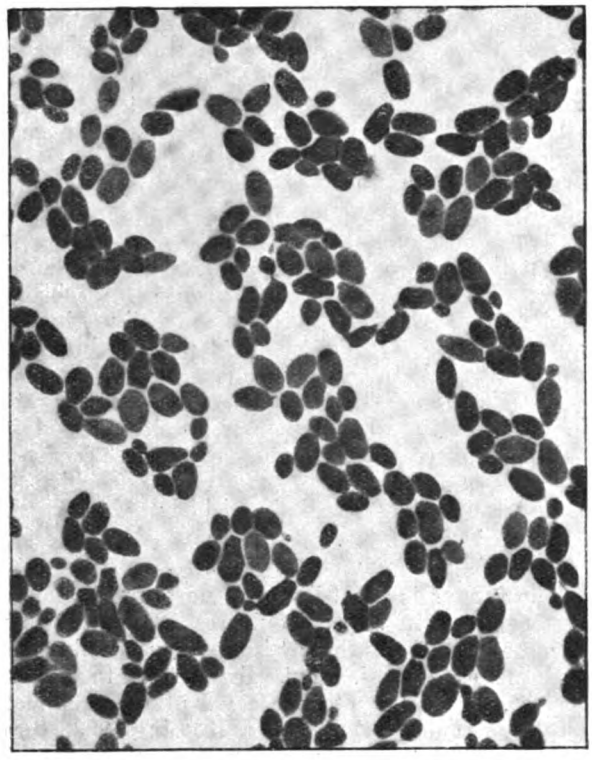
(B) MYCELIUM PRESENT.—*Monilia*.

Our fungus presents, when grown on certain media, especially fluid media, a slight amount of mycelium, therefore its correct botanical position is probably in the genus *Monilia* rather than in the genus *Cryptococcus* in which I at first placed it.[1]

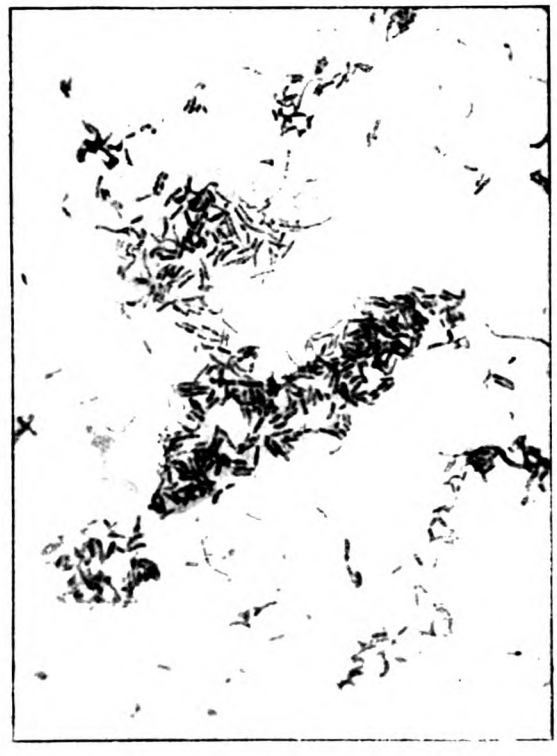
SYMPTOMATOLOGY OF FURUNCULOSIS BLASTOMYCETICA (PSEUDO-FURUNCULOSIS MYCETICA *vel* MONILIACA

[1] In practice an elaborate botanical classification of the yeast-like fungi is not necessary, and for ordinary purposes I have found the following scheme useful for the classification of these organisms:—

(*a*) Asci present	Mycelium absent—*Saccharomyces* sensu lato.
	Mycelium present—*Endomyces* sensu lato.
(*b*) Asci absent	Mycelium absent—*Cryptococcus* sensu lato.
	Mycelium present—*Monilia* sensu lato.

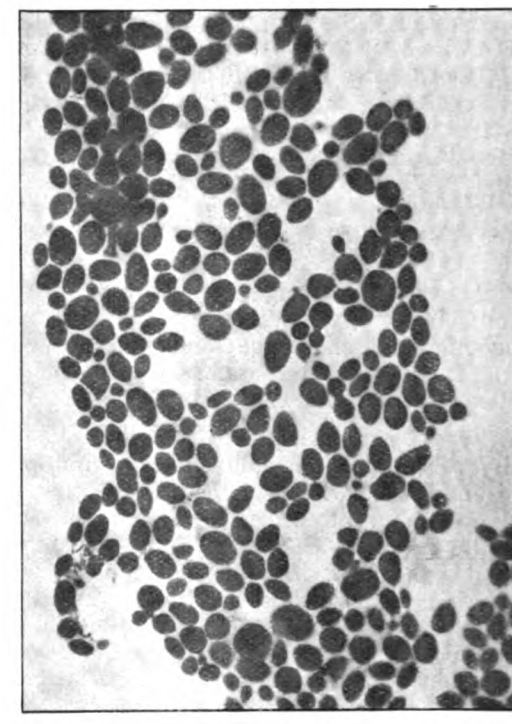


Cryptococcus macroglossiæ Castellani. × 1280.

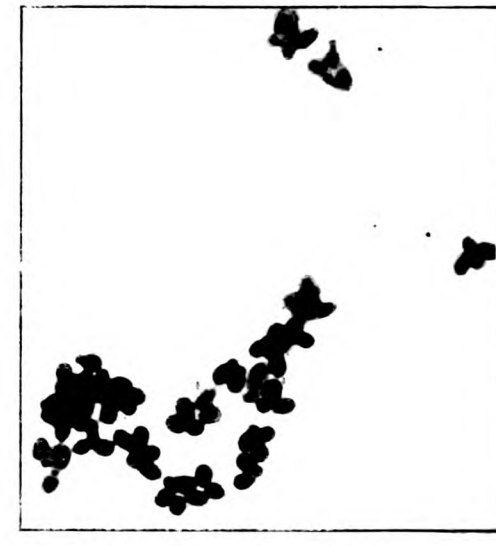


Bacillus vermiculoides Castellani. × 1280.

vel CRYPTOCOCCICA, FOLLICULITIS DECALVANS CRYPTOCOCCICA).—The clinical picture of this condition is totally different from the usual types of blastomycosis cutis which are characterized by the



Yeast like fungus from pseudo-furunculosis blastomycetica × 1280.



Cryptococcus graciloides Castellani. × 1280.

presence of patches with vegetating papillary excrescences which give them a characteristic verrucose or warty appearance. Furunculosis blastomycetica is clinically indistinguishable from ordin-

ary severe furunculosis. Boils, indistinguishable from ordinary boils, may be present on the face and body, but the region, as a rule, mostly affected is the scalp. In this region numerous pustules, flattened or conical, each pierced by a hair, may be seen; in addition there may be infiltrated lesions



Yeast-like fungus from a case of macroglossia blastomycetica. Glucose agar culture.

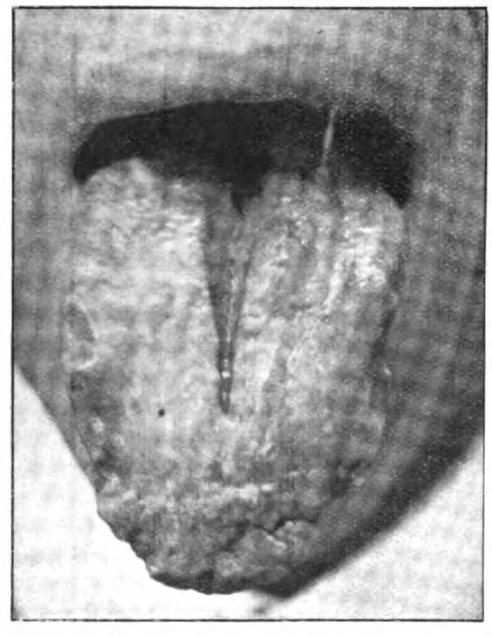


Yeast-like fungus isolated from a case of furunculosis blastomycetica. Glucose agar culture.

somewhat resembling flat carbuncles, which later on open and discharge through several openings. The hair in the affected areas falls off and patches of baldness, sometimes permanent, remain. The treatment I have found most useful is to give large doses of potassium iodide; vaccines prepared with the fungus seem to be useful. Staphylococcus vaccine has no action on the condition, and this shows that the fungus, and not the staphylococcus which is found in practically all the lesions together with the fungus, is the real causative agent of the condition.

(2) Yeast-like Organism from a Case of Macroglossia Blastomycetica (*Cryptococcus macroglossiæ*, *Monilia macroglossiæ*).

In Ceylon during the period 1903-1915 I observed three cases of a peculiar type of macroglossia of blastomycetic origin. Two years ago an interesting case of macroglossia of the same type was kindly sent to me by my friend Dr. Broughton Alcock,



Macroglossia blastomycetica.

and in this case, too, I isolated a yeast-like organism. A full account of the case from a clinical point of view will be given at an early date by Dr. Alcock and myself.

Description of the Organism.—Yeast-like fungus, Gram-positive, not acid-fast. The individual cells are oval, of rather large dimensions, the maximum diameter varying between 4 and 5 microns.

Cultural and Biochemical Characters.—Glucose agar.—Abundant growth, smooth surface, white colour.

Ordinary agar.— Same characters as on glucose agar, but less abundant.

Glycerine.—Not liquefied.

Serum.—Not liquefied.

Sugar Peptone Waters.—Does not produce gas in any sugar or other carbohydrate. Very rarely it may produce a slight amount of acidity in glucose.

Litmus Milk.—No change.

Agglutination.—Agglutinated by the patient's blood (1 in 400); not agglutinated, or only very slightly so, by the blood of patients suffering from furunculosis blastomycetica.

Presence of Asci and Mycelium. Asci have never been observed even in very old cultures; a little mycelium is not rarely visible in certain cultures, especially in fluid media. It is, therefore, probably more correct to place this fungus in the genus *Monilia* instead of the genus *Cryptococcus* as I originally did. If we place it in the genus *Monilia* it belongs to the *zeylanica* type (absence of gas in every sugar); it differs from *Monilia zeylanica* in not producing pigment, the cultures of *Monilia zeylanica* being yellow. The correct name for the organism would be *Monilia macroglossiæ* Castellani (syn. *Cryptococcus macroglossiæ* Castellani).

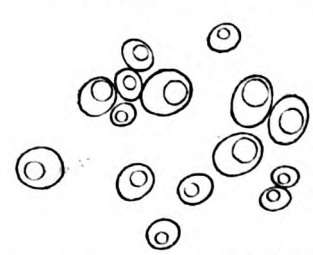
Remarks on macroglossia blastomycetica.—The whole tongue is very greatly enlarged, occasionally painful; the patient feels discomfort in eating, may have some difficulty in speaking; he cannot whistle. It may be very difficult to make the clinical diagnosis of blastomycetic macroglossia, as the tongue, though very greatly enlarged, may show almost complete absence of verrucoid patches so typical of blastomycosis. Deep scrapings should be made from the tongue after drying and painting with tincture of iodine, and cultures made. The finding of yeast-like organisms in superficial scrapings of the tongue has no importance as these fungi are not rarely found in that situation even in normal mouths. Potassium iodide has a very beneficial effect on the condition. Vaccines prepared with the fungus seem to be useful.

(3) Yeast-like Fungus and Bacillus living in Symbiosis, isolated from cases of Peculiar Mycotic Stomatitis.

From certain cases of stomatitis, clinically totally different from thrush, I have isolated a fungus and a bacillus which apparently live in symbiosis, both in the lesions and in cultures. In glucose agar cultures a number of minute almost streptococcus like colonies will be seen. The microscopical examination of any of these colonies will show presence of both the delicate yeast-like fungus and the bacillus. For many months I did not succeed in separating the two organisms by plating and various other devices. I noticed that a high temperature



Case of folliculitis decalvans cryptococcica.



Yeast-like fungus from a case of folliculitis decalvans cryptococcica (glucose-agar culture).

TABLE I.—SHOWING CULTURAL AND BIOCHEMICAL CHARACTERS OF YEAST-LIKE FUNGI ISOLATED FROM CASES OF FURUNCULOSIS BLASTOMYCETICA AND MACROGLOSSIA BLASTOMYCETICA.

Organism	Motility	Gram	Litmus milk	Lactose	Glucose	Levulose	Maltose	Galactose	Saccharose	Mannite	Dulcite	Salicin	Inosite	Dextrin	Inulin	Sorbite	Adonite	Arabinose	Raffinose	Isodulcite	Erythrite	Glycerine	Gelatine	Serum	Glucose-agar
Yeast-like organism from furunculosis blastomycetica, English cases.	O	+	O	O	AG	AG	O	O or A	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	White at first, then yellowish brownish
Yeast-like organism from macroglossia blastomycetica	O	+	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Permanently white

TABLE II.—SHOWING CULTURAL AND BIOCHEMICAL CHARACTERS OF *Cryptococcus graciloides*, *Bacillus vermiculoides* and mixed cultures.

Organism	Motility	Gram	Litmus milk	Lactose	Glucose	Levulose	Maltose	Galactose	Saccharose	Mannite	Dulcite	Salicin	Inosite	Dextrin	Inulin	Sorbite	Adonite	Arabinose	Raffinose	Isodulcite	Erythrite	Glycerine	Gelatine	Serum	Glucose-agar
Cryptococcus graciloides Castellani	O	+	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Minute colonies.
Bacillus vermiculoides Castellani	O	+	A or AC	A	A	A	A	A	O	O	O	O	O	O	O	O or A *v.* S	O	O	O	O	O	O	O	O	Minute colonies.
Mixed culture ...	O	+	AC	A	A or AG	AG	A or AG	A	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Minute colonies.

A = acid. G = gas. O = absence of gas or coagulation. C = presence of clot. + = positive. S = slight.

(37° C.) increased the growth of the bacillus, while a low temperature was somewhat unfavourable to it. I noticed also that in McConkey lactose agar tubes, the fungus had a tendency to become more abundant, while the bacillus had a tendency to become more scanty. Making use of these two observations by repeatedly inoculating McConkey lactose agar and keeping some of them at 37° C., others at 15-22° C., I succeeded finally in separating the two organisms, of which I will give here a brief description.

(A) Yeast-like Fungus (*Cryptococcus graciloides* n. sp.).—Very delicate yeast-like organism, Gram-positive, not acid-fast. Each cell is roundish or more often oval, with frequently a flask-like shape. In preparations from the cultures the average maximum longitudinal diameter of most cells is 3 to 4·5 microns, and the maximum average transverse diameter is 2 to 3 microns.

Cultural and Biochemical Characters.—Glucose Agar.—Minute colonies somewhat streptococcus-like.

McConkey Lactose Agar.—Minute colonies, but growth often more abundant than on glucose agar.

Gelatine and Serum.—Growth exceedingly scanty; neither of the media is liquefied.

Lead Agar.—No evident darkening of the medium.

Glucose and Other Sugar Peptone Waters.—Apparently no production of acidity or gas, but the organism grows extremely scantily in these media, and sometimes no growth at all takes place.

Classification of the Organism.—As the fungus is morphologically yeast-like, it comes under the general heading "Yeast-like Fungi," the classification of which I have briefly described in the first section of this paper.

This yeast-like fungus never shows presence of asci, mycelium is completely absent, the budding takes place by one budding at a time; the organism does not produce a thick pellicle in fluid-sugar media; it should therefore be placed in the genus *Cryptococcus*. The peculiar flask-like appearance often shown by this fungus might be an argument to place it in another genus, the genus *Pityrosporum*, which is said to differ from the genus *Cryptococcus* as follows:

(1) The vegetative cells have a flask-like appearance and do not show a well-marked double contour. (2) It has not been cultivated.

The genus *Pityrosporum* Sabouraud, 1895, contains two species, *Pityrosporum ovale* Bizzozzero, 1882, and *Pityrosporum cantliei* Castellani, 1908. Morphologically the fungus I have isolated is very similar to *P. ovale*, but it differs from it in the fact that it is of smaller dimensions and is cultivable, and, moreover, certain cells may show a double contour. In my opinion the fungus should be placed in the genus *Cryptococcus*.

Bacillus vermiculoides n.s.—This bacillus apparently lives in symbiosis with the *Cryptococcus* I have described; I have separated the two organisms with great difficulty, but I now have pure cultures of both. The bacillus is of rather large dimensions, its length varying between 2 and 6 microns; it is often curved in shape. It is Gram-positive, not acid-fast. The optimum temperature seems to be 37 C., but may grow, though much less abundantly, at much lower temperature, 22 C. and even less.

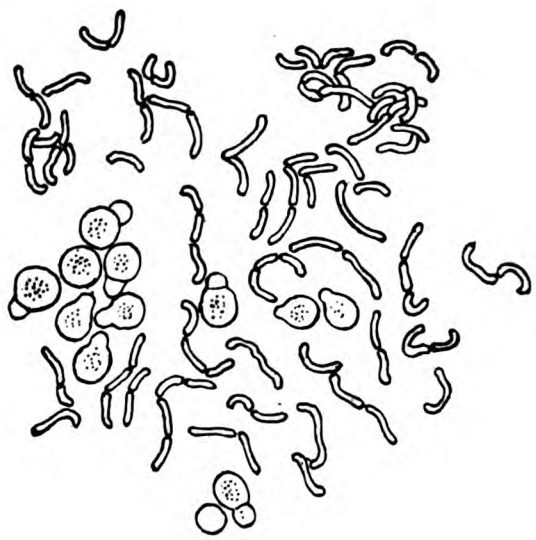
Glucose Agar.— Minute colonies somewhat resembling those of certain streptococci.

Gelatine.—Growth very scanty or absent altogether, no liquefaction.

Serum.—No liquefaction of the medium.

Sugar Peptone Waters.—It produces acidity, but no gas in glucose, levulose, maltose, galactose and lactose. There is usually no change in the other sugar-peptone waters.

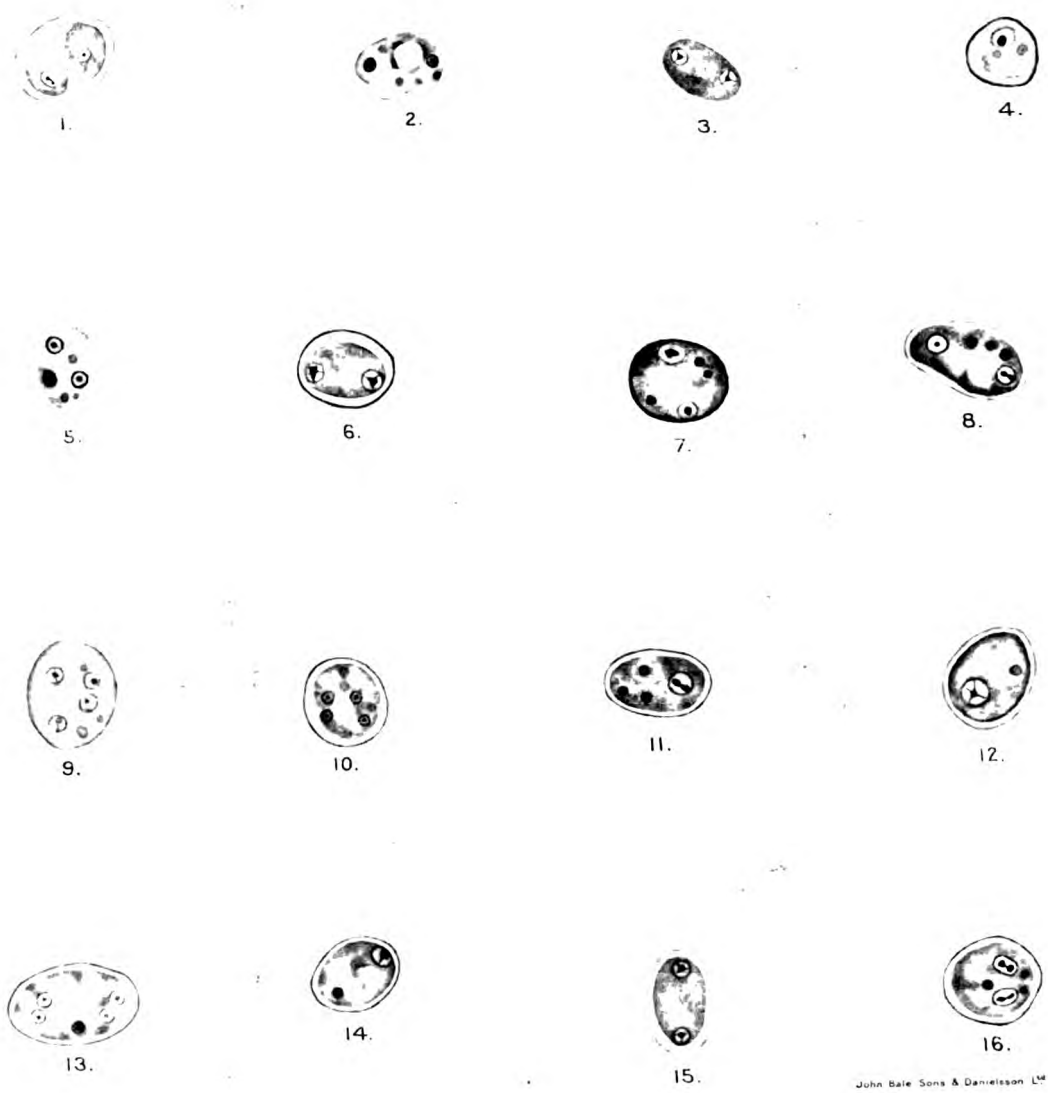
Litmus Milk.—The medium is rendered acid and after a time may become clotted.



Symbiosis of *Cryptococcus graciloides* and *B. vermiculcides*. (From glucose-agar culture.)

Biochemical Reaction of the Associated Organisms.—When sugar media are inoculated with a mixed cryptococcus—bacillus culture, acid and gas are produced in glucose and levulose; only acidity in lactose, maltose and galactose; litmus milk is rendered acid and clotted.

Remarks on the Stomatitis from which Cryptococcus graciloides and Bacillus vermiculoides have been isolated.—The appearance of the lesions is quite different from thrush. The patches, which are generally of large dimensions, are hardly raised at all, and are not cream-white; they have the appearance of a thin translucid whitish film covering parts of the oral mucosa, occasionally giving the impression of being patches of incipient diffused leukoplakia, but the microscopical examination of scrapings will clear the diagnosis. The



To illustrate article on "The Cysts of *Tricercomonas intestinalis* Wenyon and O'Connor 1917 found in Human Faeces," by J. G. THOMSON, M.A., M.B., Ch.B., and ANDREW ROBERTSON, M.B., Ch.B.

first two cases of this stomatitis I observed in Central America; very recently I have seen a case of the same, or of a very similar condition, in England, but the investigation of this case has not yet been completed.

THE CYSTS OF *TRICERCOMONAS INTESTINALIS* WENYON AND O'CONNOR 1917 FOUND IN HUMAN FÆCES.

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INTRODUCTION.

THE cysts of *Tricercomonas intestinalis* were found in large numbers in the stools of a case convalescent from sprue. The patient was under the care of Dr. P. Manson-Bahr, to whom the authors are desirous of expressing their appreciation of his kindness in giving them access to the material for examination. The patient had returned fairly recently from India, where he had been stationed in the neighbourhood of Madras.

As the cysts of this minute human parasite have been recorded only on four occasions, viz., by Wenyon and O'Connor (1917), Jepps (1921), Lynch (1922), and Boeck (1924), a further description of their morphological characters seems to fulfil a useful purpose, as, owing to their large numbers in the present case, it has been possible to study them carefully, and thus confirm the observations of others. There seems little doubt that many cases of infection with this parasite must fail to be diagnosed, as the cysts especially are small in size and can be easily overlooked.

Wenyon and O'Connor, in their original description of the genus *Tricercomonas*, mentioned cysts which occurred in a case infected with this flagellate, and suggested their association one with the other. Jepps and Lynch both described the cysts in connection with the flagellate, and finally Boeck definitely established the relationship by obtaining the cysts in cultures of the flagellate on Locke's egg-serum medium.

DISCUSSION REGARDING THE GENUS *Tricercomonas* AND CERTAIN DOUBTFUL GENERA AND SPECIES OF FLAGELLATES DESCRIBED AS OCCURRING IN THE INTESTINE OF MAN.

The following free flagellates have been named and described as genera and species occurring in human fæces:—

Enteromonas hominis da Fonseca 1915, *Octomitus hominis* Chalmers and Pekkola 1916, *Monocercomonas* Chatterjee 1917, *Trichomastix hominis* Chatterjee 1917, *Tricercomonas intestinalis* Wenyon and O'Connor 1917, *Diplocercomonas soudanensis* (*Dicercomonas soudanensis*) Chalmers and Pekkola 1919, *Enteromonas bengalensis* Chatterjee 1919.

With the exception of *Enteromonas hominis* and *Tricercomonas intestinalis* the above have been found and described once only, and it is felt that, in view of the extreme difficulty of studying accurately such small flagellates, and the fact that the original descriptions and figures of the various authors are not so convincing as they might be, it is impossible to accept these as true genera and species until further observations of a confirmatory nature have been made. The genus *Enteromonas*, on the other hand, was created by da Fonseca in 1915 for an intestinal flagellate found in the fæces of a woman in Brazil, and since then has been described on several occasions. Chalmers and Pekkola have recorded four cases: (1) in the fæces of a woman in Khartoum (1917), (2) in the case of a British officer at Omdurman (1918), (3) in a Sudanese soldier at Omdurman (1918), and (4) in a male Sudanese convict in the central prison of Khartoum North (1918). Noller (1921) reports one case. Da Fonseca and Chalmers and Pekkola are in agreement that the flagellate is small in size, oval, rounded or irregular in shape with alveolated cytoplasm. The oval forms are about 5·5 microns long by 4 microns broad, while the rounded forms are 4 microns to 4·5 microns in diameter. There are three anterior flagella, two of equal length and one longer, and all are directed forwards. Chalmers and Pekkola describe two blepharoplasts—one, from which the two equal flagella take origin, slightly anterior to the other, which serves as the point of origin of the single long flagellum.

More recently Lynch (1922) described an *Enteromonas* from a guinea-pig (*Enteromonas cavix* Lynch 1922) with three anterior flagella, two shorter ones directed anteriorly, and a third longer flagellum directed posteriorly but not attached to the body, which he was able to compare with a *Tricercomonas* from a human patient. The *Tricercomonas* was somewhat similar in general appearance to the *Enteromonas* in the guinea-pig, but had four anterior flagella, three of which were directed forwards, while the fourth, rather longer than the others, was recurrent, and was attached to the surface of the body for about three-quarters of its length. Lynch succeeded in cultivating both these organisms.

This work of Lynch is of importance because Dobell and O'Connor (1921), from an examination of the literature and the drawings given by the various authors, arrived at the conclusion that *Tricercomonas intestinalis* Wenyon and O'Connor 1917 was identical with *Enteromonas hominis* da Fonseca 1915, and, while accepting the description of Wenyon and O'Connor as the correct one, placed their name *Tricercomonas intestinalis* as a synonym. Dobell and O'Connor have gone still further and have grouped under the name *Enteromonas hominis* the entire list of flagellates given at the beginning of this section. This well-meaning attempt on the part of these authors to simplify the position with regard to this group of flagellates

has really resulted in a greater degree of confusion, and is quite unjustifiable. Until the original preparations on which these genera and species were created are re-examined and redescribed, or until confirmation is arrived at by other means, these genera and species with their descriptions must stand. It is particularly desirable that the original films, if these are still available, should be studied again, as it is quite probable, given that the original descriptions have been inadequate or inaccurate, that the various flagellates might be small races of well-known parasites such as *Trichomonas* or *Chilomastix* or even coprozoic organisms.

This discussion can be concluded by accepting *Tricercomonas intestinalis* Wenyon and O'Connor 1917 as a definitely described intestinal parasite of man, which has been reported, including the present case, on seventy-six occasions. The cysts have been seen in five cases associated with the vegetative forms. *Enteromonas hominis* da Fonseca 1915, *Octomitus hominis* Chalmers and Pekkola 1916, *Trichomastix hominis* Chatterjee 1917, *Monocercomonas* Chatterjee 1917, *Diplocercomonas soudanensis* Chalmers and Pekkola 1919, *Enteromonas bengalensis* Chatterjee 1919, are regarded as doubtful genera and species.

TABLE OF HUMAN CASES OF INFECTION WITH *Tricercomonas intestinalis* WENYON AND O'CONNOR 1917.

Observer	Year	Free flagellates About	Cysts
Wenyon and O'Connor ...	1917 ...	12 ...	1
O'Connor	1919 ...	16 ...	0
Kofoid, Kornhauser and Plate	1919 ...	2 ...	?
Kofoid and Swezy	1920 ...	6 ...	?
Jepps	1921 ...	1 ...	1
Lynch	1922 ...	1 ...	1
Jepps	1923 ...	36 ...	0
Boeck	1924 ...	1 ...	1
Thomson and Robertson ...	1925 ...	1 ...	1
		76	5

Neither in the paper by Kofoid, Kornhauser and Plate (1919), nor in the one by Kofoid and Swezy (1920), was it stated whether the diagnosis was made on the presence of cysts or free forms.

DESCRIPTION OF THE FREE FORMS.

The morphological characters of this flagellate have been described by Wenyon and O'Connor, and their observations have been confirmed and amplified by Lynch (1922), Jepps (1923), and Boeck (1924). The habitat is probably the lower intestine (*vide* Lynch 1922).

The shape of the body varies according to the angle from which it is viewed. The contour is roughly pear-shaped, the anterior end being rounded and the posterior extremity drawn out to a point, but while one side is convex the other tends to be flattened and possibly has a longitudinal groove. The free forms are extraordinarily active, and, in addition, the body is remarkably mobile, both Jepps and Boeck having described it as extremely amœboid or plastic. The measurements in the long axis have been given as between 4 microns and 10 microns, and probably the largest number are about 7 microns or 8 microns long. The breadth varies from 3 microns to 6 microns.

The nucleus is single, vesicular, spherical or ovoid, and measures from about 1·5 microns to 2 microns in diameter. Jepps, Lynch and Boeck all show in their drawings a centrally placed karyosome, small in size and generally in a single mass, although sometimes it may be divided into two or three granules. Variations in the size of the karyosome have been depicted, but this is possibly due to imperfect differentiation.

Two blepharoplasts have been noted near the nucleus. In one of these, which is situated slightly anterior to the other, three flagella of equal length arise and are directed forwards. The fourth flagellum takes origin from the more posterior of the blepharoplasts, curves backwards and runs along the flattened lateral margin towards the posterior extremity, when it becomes free for a very short distance. According to Lynch this posteriorly-directed flagellum appears to be attached to the body for about three-quarters of the body length, whereas the figures of Wenyon and O'Connor, Jepps, and Boeck seem to indicate that it may be adherent throughout the entire length of the body.

In the present case only a few examples of the free forms were found in stained preparations, and, although these were insufficient for further morphological observations, they were easily identified as the free forms of *Tricercomonas*, and thus could be associated with the numerous cysts present.

THE CYSTS.

In all the specimens examined from this case the cysts were very numerous, and were carefully studied in normal saline, in iodine solution, and in fixed and stained preparations.

They were most commonly oval in outline with a distinct cyst wall, but many distorted forms were seen. They varied in length between 6 microns and 8 microns, and in breadth between 4 microns and 6 microns. The average size was 7 microns by 5 microns. These measurements are in accordance with those of previous observers.

The cytoplasm is finely granular, and may be vacuolated (figs. 2, 4, 7, 8, 10, 11, 13, 14 and 16). In some of the cysts (figs. 1 and 9) the cytoplasm has an appearance suggestive of its being divided into two portions, as if the body substance divided along with the nuclei.

Included in the cysts were certain bodies more or less rounded in outline and highly refractile when examined in the fresh unstained condition, suggestive of chromatoid material (figs. 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14 and 16). In iodine solution, however, they became brown in colour. Fixed and stained in Ehrlich's acid or Heidenhain's iron hæmatoxylin they became almost black, but were comparatively easy to decolorize during the process of differentiation, more so than the chromatoid bodies of amœbic cysts. When the specimens stained in Ehrlich's acid hæmatoxylin were differentiated and counte

stained in eosin, it was found that these round bodies had taken up the pink of the eosin more intensely than any other part of the cell. The nature of these inclusions seems to suggest volutin. They were not constantly present, but the majority had a varying number in their cytoplasm, sometimes so numerous as to completely obscure the other contents. Boeck (1924) drew attention to these granules in the cyst, and depicted them in his drawings.

The nuclei, which were situated at the ends of the cysts, numbered one, two or four. The binucleate forms predominated; indeed the uninucleate and quadrinucleate forms were somewhat difficult to find. The nuclei were spherical, vesicular, and had a well-marked nuclear membrane. The karyosome was usually small, rounded, and consisted of a single mass from which fine threads could be made out radiating to the nuclear membrane (figs. 3, 6, 8, 12, 14 and 15). In a fair proportion of the cysts, especially the binucleate forms, the karyosomes were frequently dumbbell-shaped (figs. 1, 7, 8, 11 and 16). This was noted by Wenyon and O'Connor. No nuclear chromatin could be made out apart from the karyosome, but the nuclei were so very small that it is impossible to be certain on this point.

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DESCRIPTION OF PLATE.

Cysts of *Tricercomonas intestinalis* Wenyon and O'Connor 1917, stained with Heidenhain's iron hæmatoxylin or Ehrlich's acid hæmatoxylin and drawn at a magnification of 2,000 diameters (approx.).

1. Binucleate cyst. Shows a well-marked dividing line in the cytoplasm, as if the contents of the cyst were differentiated into two parts. One of the nuclei shows the dumbbell-shaped karyosome.

2, 5, 7, and 8. Binucleate cysts showing the peculiar granular inclusions. In 8 one of the nuclear karyosomes is dumbbell-shaped.

3, 6, and 15. Cysts which have each two nuclei in which fine threads, probably of linin, can be made out between the karyosome and the nuclear membrane.

4. Small cyst, uninucleate. Probably an oval cyst seen end on.

9, 10, and 13. Four nucleated cysts each of which show the characteristic inclusions. In 9 the contents appeared to be separated into two portions.

11, 12, and 14. Uninucleated cysts. 11 shows the dumbbell-shaped karyosome. 12 shows the threads radiating from the karyosome. 14 shows the karyosome very eccentrically placed; this is rather unusual.

16. Binucleated cyst with inclusions. Both nuclei have karyosomes elongated and constricted in the middle.

THE TREATMENT OF BLACKWATER FEVER.

By Charles Lewis Trout, M.D.

General Remarks.

The African Inland Mission is conducting missionary work in Kenya Colony, Tanganyika Territory, Congo-Belge and the French Sudan. My work as a medical missionary was in the Belgian Congo under this mission. Within six months of my arrival, I came down with blackwater fever. Thus, the study of this condition was impressed upon me.

From the first, I began to search for a more reliable treatment than the one we were using in our mission. The treatment given in this article is the result.

During my five and a half years of practice in the Congo, four missionaries died from blackwater fever. All these received the Hearsey solution (one-thirtieth grain bichloride of mercury and ten grains of bicarbonate of soda) plus hypodermoclysis and good nursing. Three of these died during the second attack; one during the first attack. The latter had been in the Congo five years and took five grains of quinine daily. The others used quinine about once or twice a week. Our study of the disease covers the history of thirty-four cases with twelve suffering a second attack. Seventy-five per cent. of these patients took quinine daily. All cases had what might be called an exciting cause. One woman came down with hæmoglobinuria after a violent mis-

carriage. The majority gave a history of over-exertion under a hot tropical sun followed by sudden chilling. Most of our cases followed a visit to our main station in the Congo.

This station, Aba, is situated in the northern and eastern part of the Belgian Congo near the English Sudan. The altitude of this station is a little over 3,000 ft. A rocky hill rises some 200 ft. above the surrounding plain. The mission is located upon this hill. Much time and money have been expended in an effort to make the hill mosquito proof. Every prophylactic measure is being used by the missionaries to prevent malaria fever. Nevertheless, Aba continues to be an endemic centre for blackwater fever.

Because of these facts, we thought there might be a specific cause for this malady. All our cases have shown a history of malaria fever usually subtertian in type. All have had a low percentage of hæmoglobin, but we have been unable to discover any specific cause.

Prophylactic Measures.

Personal Hygiene: Clothing.—Dress for the weather and for the time of day. Use silk woollen underwear. Keep the abdomen warm. Put on heavier garments for evening.

Bathing.—Never take cold baths in the tropics. Use warm or hot water. Bathe in the early afternoon and have the room warm.

Sun.—Avoid exposure to the sun during the heat of the day, 11 a.m. to 2 p.m. Wear a good helmet when in the open from sunrise to sunset.

Refrigeration.—Be careful of exposure to weather changes. Change clothing whenever dampened by perspiration from exercise. Guard against getting chilled.

Fatigue.—Avoid over-exertion while walking, overwork and anxiety of all kinds.

Diet.—Do not eat too much meat. The tendency in the tropics is to have meat at all meals. With proper planning vegetables can be had throughout the year in nearly all parts of Central Africa. Have salads of lettuce, cabbage, fruits, once or twice daily. Beets, carrots, squash and potatoes can be grown. Greens can be obtained from the natives. Use fresh fruits in season and have dried fruits on hand.

Malaria.—All evidence now seems to point to malaria as the main cause of hæmoglobinuria. The blackwater fever patient is one whose blood integrity has been lowered by repeated attacks of malaria invariably of the malignant tertian type. The chief contributing factors are over-exertion on safari, exposure to wet and cold, and lowering of vitality by some sudden acute illness.

Every means must, therefore, be used to prevent infection with the plasmodia of malaria. Dwellings should be mosquito tight, traps placed to catch the egg-layers, swamps drained, foliage near living quarters destroyed, and every known means used to exterminate and prevent the breeding of anopheles.

Cases suffering from malaria ought to be isolated in such a manner as to prevent mosquitoes from feeding upon them. Crude oil with some castor oil should be poured over pools that cannot be drained. The individual himself should be careful to have good mosquito boots and to use them, and to have a mosquito proof net in constant service. If one is reasonably sure they have not been bitten it may be all right to take quinine twice a week, but in badly infested areas it is better to take quinine daily. The best time to take quinine is at bedtime, and we advise five grains as the proper dose. Those who have had the blackwater fever should use quinine tannate. Every system of prophylactic quinine treatment has been used, and we have had missionaries develop the subtertian type of malaria even while taking the quinine.

Most important of all is the thorough and systematic Treatment of every Attack of Malaria Fever.

We recommend the following treatment of malaria:

(1) Give the patient one grain of calomel with ten grains of bicarbonate of soda.

(2) Inject intramuscularly five grains of quinine dihydrochloride. Observe strict asepsis.

(3) Give by mouth gelsemium tincture (P. D. and Co.) ten drops in one ounce of water one teaspoonful of this solution every fifteen minutes until the patient perspires or the physiological symptoms appear.

(4) Two hours after the hypodermic injection of quinine, start quinine by mouth. Use this prescription: Take

Quinine sulphate	1 oz.
Phosphate of iron	1 dr.
Sugar of milk	1 oz.

Triturate thoroughly and fill capsules with two grains of the mixture.

Every two hours for sixty consecutive hours give two capsules of the quinine and iron phosphate mixture. At close of this treatment and two hours after the last capsule give five grains of dihydrochloride of quinine intramuscularly.

(5) Take no quinine for five days. During this interval take Fowler's solution, two drops in water, morning, noon and night. On the sixth day, start the quinine and iron phosphate treatment again. This time do not take the intramuscular injections. Start treatment with the calomel and every two hours for sixty consecutive hours take two capsules of the quinine mixture.

Note.—Six hours after the calomel take a large dose of Epsom salts. Keep the bowels open during the treatment. It is well also during treatment to take every night one half-teaspoonful of bicarbonate of soda in water. The success of the treatment will depend upon the faithfulness of the patient in taking the quinine *every two hours for sixty consecutive hours*. This method has seldom failed. It should be repeated at least twice. After all cases of malaria the blood should be examined carefully and means taken to restore the number of corpuscles and the hæmoglobin to normal. Where possible the patient should be removed to a high altitude if the hæmoglobin percentage has fallen very low.

THE PROPER TREATMENT OF EVERY ATTACK OF MALARIA IS UNDOUBTEDLY THE BEST PROPHYLACTIC AGAINST BLACKWATER FEVER.

Patients having malarial fever should have the best possible protection during the period of chilliness. Use hot water bottles, hot drinks, blankets and hot enemata if necessary.

It is well to remember that the transition from the tropics to the temperate zone is trying on the person who has had blackwater fever and that one needs to be cautious about exposure to wet and cold for at least one year after their arrival in their own country.

Drug prophylaxis.—We advise a tonic tablet with the phosphates of iron, strychnia and hydrastin of each $\frac{1}{100}$ grain. This tablet is given after acute illness or whenever the blood is poor. The tablet is preferred in the tropics to liquid tonic as it is more compact and keeps well. Where high altitudes (over 6,000 ft.) are accessible it is best to have the patient, as soon as convalescence permits, removed to the higher elevation. Several of our cases have been sent to stations over 7,000 ft. and have remained on in the tropics for five years and never had any further trouble from blackwater fever. Of course they stayed in the highlands all of this time and were kept free of malarial fever.

TREATMENT IN DETAIL.

General Measures: *Rest.*—Absolute rest in bed. Keep patient quiet. Do not permit him to sit up as there is danger of heart failure. Use bed-pan.

Sick-room.—Keep it clean and well ventilated. Maintain an equable temperature.

Diet.—During the first twenty-four hours give fruit juice sweetened to taste. Orange juice is best. Tea may be given. One method of treatment is to use forty green coffee beans boiled vigorously for twenty to thirty minutes in a pint of water. This is drunk freely and frequently. We inject caffein instead. Give lots of fluids. After vomiting is controlled give liquid nourishment every two hours. Later every three hours. As patient improves, begin return to regular diet. Start first with barley water, then dilute milk (lime-water one part, milk two parts) sweetened to taste. Give orange juice or carbonated water to quench thirst. As stomach grows stronger give beef juice, chicken broth, gruels and solids. During convalescence the diet is also important and should receive study. We give vegetables and salads with a high iron content.

Baths.—To reduce temperature it is sometimes necessary to use wet-pack or blanket bath. These also help to improve the general system by their stimulating effect. Cold enemata may be used to lower fever.

Bowels and Kidneys.—Bowels should be kept open with enemata. For kidneys give plenty of fluids by mouth: barley water, weak infusion of cascarilla or orange juice, lime juice or egg-water. Hypodermoclysis: Salt solution subcutaneously or intravenously. Glucose (one dram to one pint of salt solution) may be given with advantage intravenously. Hot applications to the loins every fifteen minutes when suppression of urine is present.

Stomach.—Vomiting is one of the most troublesome symptoms. Mustard plaster over the pit of stomach. Adrenalin 1 : 1,000 solution two drops in a teaspoonful of water every fifteen minutes for a few doses or tincture of iodine in the same manner or in smaller dose. If unable to control vomiting resort to rectal feeding.

Routine Drug Treatment.—My experience has taught me that the care given in the first twelve hours will largely foretell the ultimate outcome. For sake of description we outline the treatment under the main symptomatic stages.

During Rigor.—Put patient to bed. Keep him quiet. Use blanket and hot water bottles. A hot salt solution enema should be given. At once inject contents of ampoule of any good anti-venom.

(*Note.*—We have used horse serum, anti-venom and bubonic plague serum, in fact any serum available, but our experience would indicate that *if there is any specific remedy it is a serum prepared by immunizing the horse against the virus of the rattlesnake.* A drug-house in New York puts out ampoules of rattle-snake virus in solutions of $\frac{1}{100}$ gr. This diluted virus alone is superior to all ordinary serums but inferior to anti-venom. Cases receiving horse-serum plus the rattle-snake virus (crotalin) showed better response than those receiving the anti-venom. Thus, it would seem that a serum prepared by immunizing the horse against the virus of the rattle-snake would be the ideal preparation.)

Spirits of camphor with small amount of whisky in hot water may be given to help patient over the cold period.

During the Hæmolytic Stage.—It is a debatable question as to how long the hæmolysis lasts, but from the standpoint of treatment it is practical to consider this stage as existing from the start of the chill to the time when the urine clears and ceases to show hæmoglobin. If the horse-serum or anti-venom has not been administered during the chill give it now. In fact the first thing to do when called to see a victim of blackwater fever is to inject the serum. If possible give anti-venom, or if this cannot be obtained give any serum available. If the course of the disease has run itself out and the urine is clear I would not give the serum but examine the blood and institute treatment to replenish it. Now is the time for hypodermoclysis and intravenous injection of salt solution. We use Parke, Davis & Co.'s salt tubes. These are convenient for the ready preparation of salt solution. I usually inject 50 to 100 c.c. of salt solution intravenously and then give more slowly a pint to a quart subcutaneously. After the serum and salt solution have been given wait about an hour and give one ampoule of caffeinæ sodio-benzoatis 0·25 grm. subcutaneously.

If fever is high use drugs and general measures to reduce temperature.

As soon as these measures have been taken we

begin giving cantharides tincture five drops in a half-glassful of water to which a teaspoonful of baking soda has been added. Of this mixture we give two teaspoonfuls every half hour with plenty of water; that is, after the cantharides the patient is urged to drink as much water as he can. Under this treatment the urine often clears within an hour.

During Period of Icterus.—When urine clears and the jaundice develops give small doses of calomel and podophyllum. We follow the calomel with soap suds enemata.

Convalescence.—Use iron tonics and careful diet. Remove patient to the highlands as soon as permissible.

Special Symptoms.—For the heart the best drug is strophanthus tincture or small doses of the alkaloid. For the restlessness good nursing, frequent bathing or alcohol rubs if patient is hot. Intravenous injections of salt solution will help, also use of endocrine preparations, especially thyroid with parathyroid and pituitrin. Where the blood is badly thinned out and patient's condition is low use blood transfusion or intramuscular injections of washed corpuscles. These methods must be understood and proper precautions taken. As a tonic nothing has given us so much satisfaction as the combination of iron phosphate previously mentioned.

Travellers in the tropics should have the following drugs ready for emergencies: ampoules of horse serum, several ampoules of anti-venom (if a serum prepared against the rattle-snake virus or anti-venom can be obtained this is the preparation to have—it might be well to have ampoules of the crotalin on hand as this can be used if the patient is sensitive to horse-serum); cantharides tincture, strophanthus tincture, tubes for preparation of salt solution, hypodermoclysis outfit, good syringe with needles, tablets of the iron, strychnia and hydrastin phosphates.

Several cases in a moribund state receiving this treatment made remarkable recovery. Since giving the serum treatment no case has been lost. One case died but did not receive this treatment. I first started using serums in 1920, in well-selected cases. The results were always good.

Summary of Treatment.—(1) General measures: good nursing, proper attention to kidneys, bowels, heart, &c.; use of-salt solution; hypodermoclysis.

(2) Administer anti-venom or horse serum: one ampoule, repeat in case of relapse. In asthmatics use crotalin $\frac{1}{100}$ gr. if there is sensitivity to horse serum.

(3) Give by mouth plenty of fluids and inject subcutaneously 0·25 grm. caffeinæ sodio-benzoatis.

(4) Administer orally cantharides tincture: prepare as follows five drops in two ounces of water to which add one dram of sodium bicarbonate. Stir this mixture well and give two teaspoonfuls every half-hour until urine is normal.

(5) During icterus give calomel in small divided doses.

(6) During convalescence give iron tonics.

PRESENCE OF SPIROCHÆTES IN THE SPUTUM OF TUBERCULOUS PATIENTS.

By Professor F. Bezançon and Dr. E. Etchegoin.

THE presence of spirochætes in the hæmoptoic sputum of tuberculous patients has, up to the present day, never been recorded by any bacteriologist.

In the course of his researches on spirochætes in general, one of us observed in the hæmoptoic sputum of a tuberculous patient, some spirochætes in the very moment of the hæmoptysis, although these did not exist on the previous days.

This observation was the starting point of our present researches, pursued during our service at the Hôpital Boucicaut as well as at the Institut Pasteur.

The results of this first part of the work have been consigned in a note to the Société de Biologie, published on December 8, 1923.

To-day, the great number of sputa examined (239 examinations) allows us to state the following:—

(1) In sputum of tuberculous individuals, one can never find the type of spirochæte which is observed in the sputum of the same patients during an attack of hæmoptysis.

(2) This type of spirochæte has nothing in common with other spirochætes of the respiratory tracts.

The 239 samples of sputa with which the researches have been carried out are divided as follows:—

Sputa non-hæmoptoic containing bacilli of Koch	140
Sputa non-hæmoptoic not containing any bacilli of Koch	69
Hæmorrhagic sputa without bacilli of Koch from bronchial dilatation	2
Hæmorrhagic sputa containing bacilli of Koch from a slight accident of pneumothorax ...	1
Hæmoptoic sputa from individuals without any doubt tuberculous	27

The results obtained are the following:—

In non-hæmoptoic sputa, with or without bacilli of Koch, we have never found the spirochæte in question, nor any other kind of spirochætes. We have not found it in the hæmorrhagic sputum of bronchial dilatation.

In the case where the hæmoptysis came on as a slight mechanical accident after an injection of azote, during a therapeutical pneumothorax, the spirochæte was also absent.

Out of 27 hæmoptoic sputa of tuberculous origin, we have found spirochætes in 26 cases.

It must be noted that in the only case where the spirochæte was not found, there were no bacilli of Koch, neither at the direct examination, nor after homogenization, although, clinically speaking, the patient was tuberculous.

Let us quote the case of two patients whose sputa had been examined forty-eight hours previous to a hæmoptysis: these presented at the moment of examination five to six bacilli of Koch per field and spirochætes were completely absent; during the attack of hæmoptysis bacilli of Koch were not numerous, on an average one per field, but, on the other hand, one could find spirochætes in the proportion of six to seven per field.

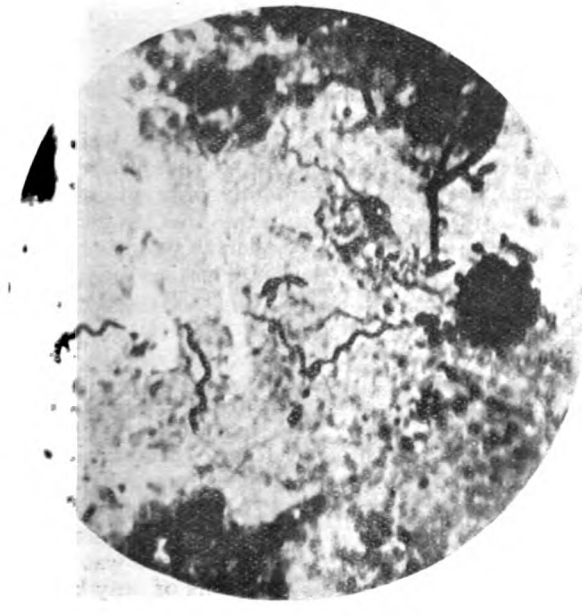
DIFFERENTIATION OF THE SPIROCHÆTA FOUND IN TUBERCULOUS HÆMOPTYSIS.

If the differentiation with the other spirochætes of the respiratory tract is not easy, in certain cases, in stained preparation or impregnated ones with silver, it is very easily made by using the ultramicroscope.

Sputa could be examined with the ultramicroscope, thanks to the following technique.

A small quantity of sputum is put in a tube containing about 1·5 c.c. of physiological salt solution; after shaking it well it is placed in the incubator at 29°, where it has to stay for thirty minutes. The biggest particles of the sputum form a sediment at the bottom of the tube, whereas the spirochætes float on the surface of the liquid.

After it has been taken out of the incubator, *without centrifuging*, a small drop is taken from the surface with the aid of a Pasteur pipette (very fine) and is examined with the ultramicroscope, using the usual technique.

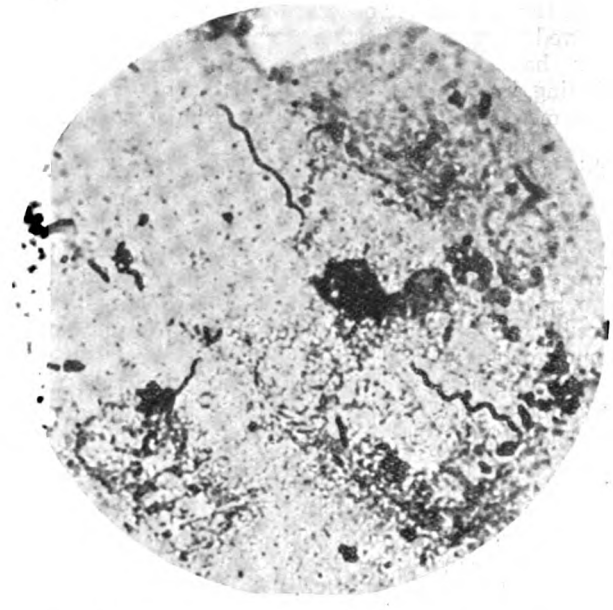


Stained smears clearly show the morphological characters of the spirochæte. Loeffler's method of staining the flagella has given us the best results, but, in the technique of fixation alcohol ether must be used instead of osmic acid.

The microbe which we have found is a spirochæta about seven to fifteen microns in length. The length of the spiral is three microns.

The *Spirochæta dentium* is clearly shorter, narrower, and the spirals are much more close together.

The *S. bronchialis* of Castellani is narrower and has its extremities nearly square; its movements are much more lively; it traverses the field of the microscope within eight to ten seconds, whereas the spirochæte of tuberculous hæmoptysis is much slower; it takes it about thirty seconds to make the same distance. Finally, the spirochæte of the tuberculous hæmoptysis, instead of having jerking motions like the *S. bronchialis*, has an almost rectilinial march.



The *S. buccalis* has its body limited by two brilliant arrows; the central core only is transparent, whereas the spirochæte of the tuberculous hæmoptysis is uniformly brilliant. Morphologically it has no relation whatever with the spirochæte of the symbiosis fuso-spirillosis of Vincent.



We have tried to cultivate the spirochæte in culture media recommended for the spirochæte of the mouth and also for other spirochætes such as the *S. ictero-hæmorrhagia*: we could not obtain any results.

Although the classification of spirochætes be difficult, we think that this spirochæte must be considered as an intermediate type between the "*buccalis*" and the "*bronchialis*" of Castellani.

If the facts so far observed are confirmed and it is proved that the spirochæte which we have observed, can be seen only in tuberculous hæmoptysis, its finding, in the absence of the bacillus of Koch, might become of the greatest interest for the diagnosis.

On the other hand, we cannot yet say what part this spirochæte plays in the causation of the hæmoptysis itself. Is the spirochæte which we have described simply a witness of the hæmoptysis, or is it the cause of certain tuberculous hæmoptysis? We shall not be able to answer this question until we have succeeded in cultivating the spirochæte; a result which we have not yet reached in spite of all our efforts.

We are also investigating the relation that might exist between the presence of the spirochæte and the change of pH of the sputa.

BENEFICIAL ACTION OF RAW PANCREAS IN CERTAIN CASES OF SPRUE. INSULIN IN CASES OF SPRUE COMPLICATED WITH DIABETES.

By Aldo Castellani, C.M.G., M.D., F.R.C.P.
Director of Tropical Medicine and Dermatology, Ross Institute, London.

For many years various pancreatic preparations and extracts have been used in sprue, but I have seldom, if ever, seen any satisfactory results from their administration. Some years ago I tried giving raw pancreas in certain cases of sprue, but the climate of the country in which the experiments were carried out rendered it practically impossible to keep the gland fresh; I then suggested that pancreas should be added to liver in the preparation of the so-called liver soup so often prescribed by practitioners in the East. During the last two years I have carried out some further researches on the administration of raw pancreas in sprue in this country, and the results have been, on the whole, satisfactory.

The routine treatment I now use in most cases of sprue may be summarized as follows:—

(1) The patient is kept at complete rest in bed.

(2) Strict milk diet, diluting the milk at first with Vichy water or plain water.

(3) In most cases, bicarbonate of soda in rather large doses, gr. xxx, or 3i, t.d. or liquor potassæ well diluted.

(4) *Raw Pancreas.*—Sweetbreads from lambs or sheep, or calves are used. They must be absolutely fresh. The gland is minced in a clean bowl or similar receptacle, or may be passed through a mincing machine; the stringy parts are removed. At first a teaspoonful, and later a tablespoonful of the chopped mass including the juice is given once or twice a day; most patients like to swallow it down with a little milk. Provided the gland is absolutely fresh the taste is not nauseating and patients soon get used to it.

When raw pancreas is unobtainable I have tried the pancreas tablets and capsules (whole substance) of Armour and other well-known firms; their action cannot be compared with that of fresh raw pancreas but they seem to be useful. Two or more tablets are given three times daily.

Insulin in Cases of Sprue Complicated with Diabetes.

During the last two years I have had the interesting experience of having three cases of typical sprue presenting at the same time the classical syndrome of pancreatic diabetes. These patients had at times pale, frothy diarrhœa, at other times they were passing bulky solid or semi-solid whitish stools; in all of them the typical sore mouth of sprue was present. In addition to the sprue symptoms, they were passing a very large amount of sugar in the urine; there was polyuria, and severe thirst. The administration of insulin in all three cases made the sugar disappear from the urine while the treatment was kept up. As regards the symptoms of sprue (sore mouth and white diarrhœa) they were slightly benefited in one case (Case I); in the other two cases no amelioration was observed.

A prolonged parathyroid and calcium lactate treatment induced an apparent cure of the sprue symptoms in Case I; practically no improvement in Cases II and III and was discontinued. In Cases II and III the administration of raw pancreas was then resorted to; it induced a slow but progressive improvement, amounting to a clinical cure. I may add that the administration of raw pancreas without insulin never controlled the glycosuria.

Insulin in Sprue not Complicated with Diabetes.

A year ago I tried small doses of insulin in a case of typical sprue without complications. The analysis of the blood did not show any hyperglycæmia, and, therefore, only minute doses (1 or 2 units) were given by subcutaneous injection, and the patient was carefully watched. No untoward symptoms of any kind were noted, but no amelioration took place in the condition of the patient. An observation I made may be put on record: the insulin increased greatly the amount of urine the patient was passing. I must add that later on the patient got quite well, but the cure could not be ascribed to the insulin, as the amelioration began three weeks after the treatment had been discontinued, and the patient was kept on milk all the time. He had neither parathyroid nor pancreas.

Résumé and Conclusions.

In some cases of typical sprue with copious white motions, sore mouth, &c., the administration of raw pancreas seems to be beneficial. It is true that all my patients were kept on a strict milk diet, and most of them had also an alkaline treatment; but my impression is that the administration of the raw pancreas accelerated the cure.

In three cases of sprue, complicated with typical

diabetes, the administration of insulin induced a disappearance of the glycosuria and polyuria, but had no distinct beneficial action—with the possible exception of one case—on the sprue symptoms. Raw pancreas given by the mouth (Cases II and III) appeared to beneficially influence the sprue condition, but did not control the glycosuria. In such cases, therefore, I advise insulin by subcutaneous injection, and the oral administration of raw pancreas.

In conclusion, I should like to state that I do not consider the mere administration of raw pancreas to be a specific treatment for sprue, but I have found it beneficial, and I venture to recommend it as an additional therapeutic measure to be combined with the usual dietetic treatments; and I see no reason why it should not be combined also with Scott's parathyroid-calcium lactate method of treatment.

FLY-PROOF LATRINES FOR COLOURED PERSONS.

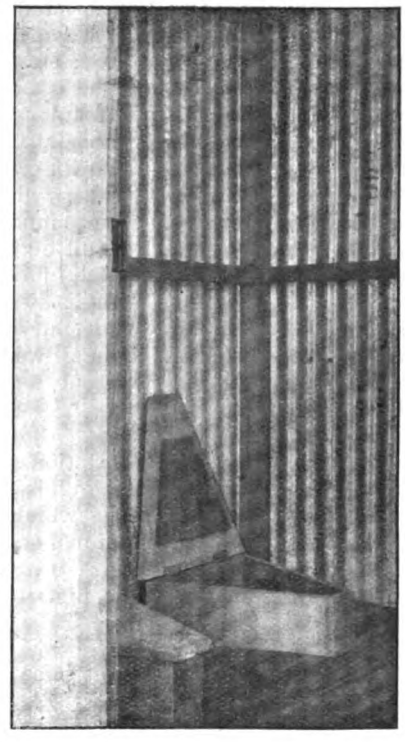
By G. A. Park Ross, M.D., D.Ph.
Assistant Health Officer for the Union of South Africa.

Most native races adopt the squatting posture with advantage to themselves.

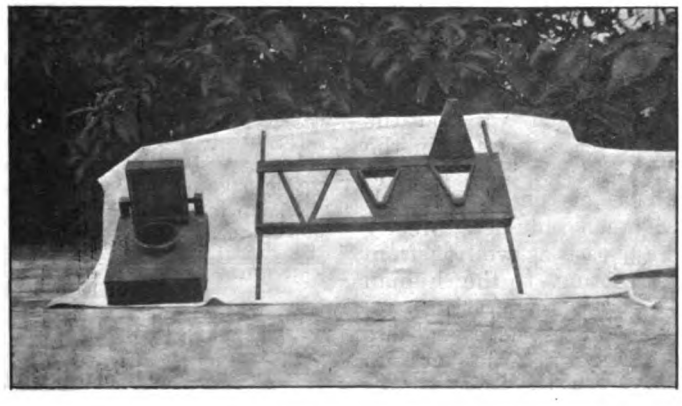
In view of the conservative characteristics of coloured races it is useless providing latrines on European lines and expecting that such will be used.

Further, many native races are careless in their mode of using a latrine, and once such has become fouled it is not used. Also they are rightly particular that their person does not touch any part of a latrine which may have been touched by another person, and if latrines are to be provided which will be of any real service these points must be attended to.

These two patterns to my design are largely used in Natal, specially the pit privy one, the deck for which costs at a large wood-working firm approximately 16s. per aperture.



I attach a photograph showing construction of a pail pattern and the pit privy pattern. In each the receptacle projects some 4½ in. above the floor. In



I find that the essential element in promoting cleanliness is to have some portion of the latrine coming up between the legs and close under the buttocks, and also that when a latrine keeps itself clean there is no difficulty in enforcing its use always provided it is easy of access and close up to coolie lines, &c.

the triangle pit privy pattern the aperture is 21 in. front to back, 3 in. in front and 18 in. behind, and the following instructions are usually sent out with it :—

(*a*) Pits to be made in dry soil to a depth of ten feet or over, but such is not necessary. The bacteriolytic action which goes on in a deep pit is very

effective, and such last for many years without requiring to be filled up.

(*b*) The pit must be completely covered over to prevent access of light. Flies will not penetrate a dark pit.

(*c*) A few spade-fulls of rich leaf mould thrown over the initial deposits of stercus are an advantage in setting up a desirable decomposition.

(*d*) In a large installation (three places or more) I advise a urine trough led to a separate pit.

(*e*) Messrs. Kynoch Ltd., Umbogintwini, near Durban, make a crystalline preparation, di-chlor-benzol, which gives off a heavy gas which is a perfect deodorant. A quarter of a pound of this hung inside the pit keeps the latter full of gas which kills any smell and through which flies cannot penetrate.

(*f*) Should a pit become flooded it must be filled with earth above floor level and some oil waste might be set to smoulder while it is drying out, a procedure which will kill any smell.

(*g*) No disinfectants should be used.

The bucket privy requires no description. I find it useless to arrange for self-closing lids. Natives simply place a stone under the hinge which is lifted off so soon as anyone tries to force down the lid.

When there are no shallow wells and the soil is porous the pit privy is much to be preferred to the bucket.

Studies Upon the Etiology of Dengue Fever (C. W. Duval and W. H. Harris, *Jour. Exper. Med.*, December 1, 1924).—The cultivation of a minute organism is described, upon the special media devised by Noguchi for growing spirochætal organisms, that gives rise to pyrexial and leucocytic reactions in the guinea-pig. The reaction in the animal following the injection of culture filtrate is identical with that induced by the inoculation of human dengue blood. The micro-organisms appear in culture as globoid bodies measuring from 0·1 to 0·3 in diameter and are arranged singly, in pairs, and in short chains. They readily pass through the Berkefeld filter (N and V), and the filtrate gives rise to a characteristic reaction in the inoculated guinea-pig. The filtrate yields in subplants the same globoid bodies of the original culture. Initial cultures have been obtained directly from the blood of the human case as well as from the blood of guinea-pigs reacting to the human material. However, only early generations retain the degree of virulence necessary to cause the experimental reaction, the culture of remote generation failing to infect. As far as is known, this minute organism has characters in common with the globoid bodies of Flexner and Noguchi obtained from cases of poliomyelitis. Examinations of blood specimens for spirochætal organisms in dengue fever patients and experimentally inoculated animals were negative. The minute organism described is frequently found in cultures of blood of human dengue and in animals inoculated with dengue material.

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THE JOURNAL OF

Tropical Medicine and Hygiene

JUNE 15, 1925.

THE JAMAICA HOOKWORM COMMISSION.

THE campaigns of the Jamaica Hookworm Commission, a branch of the International Health Board are conducted with the purpose of employing the control of hookworm disease as a means of educating the people in disease control and especially in sanitation. Thickly populated rural areas are selected

for the campaigns; these are sanitated by the Local Boards of Health several months in advance of treatment; the fly-proof type of pit latrine is generally installed, and in every case the home owner is required to build his own latrine. When a householder constructs his latrine he is much more interested in its maintenance, it has been found.

For the purposes of the treatment campaign an area is divided into districts and an officer of the Commission is given charge of each. Every home is visited, specimens are collected and brought to a central office and laboratory for examination, and the infected are treated in their homes. Educational work is conducted simultaneously with treatment and consists of lectures, illustrated with magic-lantern slides and moving pictures, microscopical demonstrations, and the distribution of public health literature. Emphasis is placed upon the methods of spread of the bowel filth diseases and the necessity for latrine maintenance is stressed. After treatment, each area is provided with permanent sanitary inspectors by the Local Boards of Health.

Routine treatment consists of alternate doses, at weekly intervals, of oil of chenopodium and thymol, with compound jalap powder for the purge. The jalap is mixed and capsulated with equal parts of thymol, just as milk sugar or soda is used, and a maximum dose of 40 gr. of thymol is given; the jalap is placed in the capsule and the oil of chenopodium dropped upon it, the maximum dose being 24 minims of the oil.

Compound jalap powder is used as a preliminary purge in maximum doses of 40 gr. and, being slow acting, can be administered any time after 2 p.m. on the day preceding treatment. Treatment is given in the morning in two parts, at intervals of two hours. By using jalap powder with the chenopodium and thymol the nausea which usually follows treatment is avoided; also the dispenser can administer the preliminary purges and the treatments much quicker and much more conveniently than when Epsom salts is employed as a purgative.

The hookworm campaigns in Jamaica, directed by Dr. B. E. Washburn, have resulted in marked decreases in the number of patients admitted to hospitals for all diseases, and especially in the number of cases of typhoid fever and dysentery. Removal of hookworm infestation has restored many individuals to health and has made it possible for them to perform more regular work, earn more money, and become better citizens.

Annotations.

Stability of Desiccated Beef Heart Muscle Powder for Preparation of Antigens for Conduct of Complement-Fixation Tests in Syphilis (R. A. Kilduffe, *Arch. Dermat. and Syph.*, December, 1924).—The results of the investigation suffice to show that a highly polytropic powder of beef heart muscle can be commercially prepared in large quantities. Such a product is eminently suitable for the preparation of highly antigenic extracts with low hæmolytic and anticomplementary titres according to Kolmer's method of antigen preparation. The powder under ordinary conditions of storage is quite stabile, satisfactory antigens having been prepared from it after eleven months. No special precautions in keeping the powder are required other than to keep the containers tightly stoppered to prevent the absorption of moisture. If the precaution is taken to shake the container frequently and vigorously during extraction, antigens of remarkable potency may be prepared; without special care, the extracts are highly antigenic and quite satisfactory. Beef heart muscle powder may be commercially prepared and stored in large quantities for at least eleven months without fear of undue deterioration.

Relation of Natural Anti-Sheep Hemolysin of Human Serums to Kolmer's Quantitative Complement-Fixation Test for Syphilis (R. A. Kilduffe, *Arch. Dermat. and Syph.*, December, 1924).—Human serum may contain natural anti-sheep hæmolysin in amounts sufficient to exhibit a specific effect in high dilutions. Human serum may contain anti-sheep hæmolysin in sufficient amounts to cause a false negative reaction in complement-fixation tests for syphilis when the serum is used in a dose of 0·025 c.c. The presence of large amounts of natural anti-sheep hæmolysin is not without effect on the reaction in Kolmer's quantitative complement-fixation test for syphilis, even when the serum contains relatively large amounts of syphilitic reagin, and may give rise to false negative results in approximately ten per cent. of hæmolysin-containing serums. The absorption of natural anti-sheep hæmolysin from the serum prior to the performance of Kolmer's quantitative complement-fixation test increases the delicacy of the reaction and may be incorporated as a part of the technique, with definite advantages. The method of Kahn for the absorption of anti-sheep hæmolysin from human serums is rapid, simple and efficacious, and does not appreciably add to the time necessary for performing the test even when large numbers of serums are examined. While Kolmer's method of complement-fixation as originally described has been shown to be superior to the majority of methods in common use, the use of hæmolysin-free serums with this technique definitely improves its delicacy.

A Study of C. diphtheriæ *and Other Members of the Genus* Corynebacterium *with Special Reference to Fermentative Activity* (M. M. Barratt, *Jour. Hygiene*, December, 1924).—In this paper the fermentation reactions and some ancillary characters of 102 strains of virulent *C. diphtheriæ*, 31 non-virulent strains and 150 diphtheroids have been studied. With the possible exception of dextrin which proved to be an unsuitable sub-

stance for biological tests all the strains of virulent *C. diphtheriæ* examined were found to have constant biochemical reactions, fermenting glucose, maltose of galactose and having no action on cane sugar, lactose and mannite. The strains classified as non-virulent *C. diphtheriæ* had the same biochemical characters as the virulent strains and were indistinguishable from them either on morphological or cultural grounds. The diphtheroids examined showed great diversity in their power of attacking the carbohydrates used, at least eleven biochemical groups being recognized. By the use of three carbohydrates glucose, galactose and cane-sugar ninety per cent. of the diphtheroids in this series could be distinguished from *C. diphtheriæ* by the fermentation reactions. In the remaining ten per cent. a clue as to the nature of the organism is often obtained from the character of the growth on agar. Among the corynebacteria examined other than *C. diphtheriæ* no constant relationship was found between source, biochemical, morphological and other characters. Nevertheless, in dealing with members of the genus in pure culture, the morphology, character of the growth on agar and fermentation reactions taken together give useful information as to whether the organism under consideration is *C. diphtheriæ* (virulent or non-virulent) or a diphtheroid.

Pathology of Experimental Pneumococcus Pneumonia in Mice (A. Branch and E. G. Stillman, *Arch. Inter. Med.*, December 1, 1924).—The administration of alcohol produces no evident histological changes in the lungs of mice. Following inhalations of pneumococci the organisms are not visible histologically in the lungs of mice either in the bronchi or alveoli. In partially immunized mice which have been exposed to a pneumococcus spray while alcoholized, true lobar pneumonia not infrequently develops. The primary lesion of such lobar pneumonia in mice is an interstitial inflammation of the alveolar wall and the infection spreads in the interstitial tissue like a cellulitis. A tentative explanation of the lobar distribution of pneumococcus pneumonia is offered.

The Penetration of Bacteria Through Capillary Spaces (Stuart Mudd and Emily B. H. Mudd, *Journal of Experimental Medicine*, November 1, 1924).—The dark-field microscope may be used to observe directly the characteristics of composite films. The liquid phases, one or both of them containing suspended solid particles as test objects (in these experiments bacteria were used), are spread between slide and cover-glass and examined with any desired lenses. The liquid-liquid interfaces appear as bright lines and the solid particles as shining motes. An interfacial kinetic mechanism has been observed in films of all compositions studied. The bacteria are transported along the phase boundary lines in a striking and characteristic manner, and quite independently of movements in the adjoining organic or aqueous phases. These movements in the interface are interpreted as essentially due, according to the composition of the films, to local inequalities in interfacial surface tension, or to minute currents from mixing of the two phases across and along their boundary line, or to both forces acting together. The bacteria (non-motile) reached the interface by Brownian movement or currents or shifts in the position of the boundary line. With liquids which differ markedly in interfacial tension and miscibility with water, these properties may be correlated with the characteristics of the preparation.

The Influence of Different Kinds of Oil, Introduced into the Rectum, on Gastric Secretion (W. N. Boldyreff and J. H. Kellogg, *Arch. Internal Medicine*, November, 1924).—The mineral oils (liquid paraffin oil) do not diminish the appetite, and do not have any harmful effect on gastric digestion. Of the animal oils, butter has no inhibiting action on digestion, because it is not liquid at body temperature, and therefore cannot move into the small intestine. Cod-liver oil inhibits digestion, but in a relatively small degree. The vegetable oils (olive oil and linseed) inhibit very strongly the psychical phase of digestion. The fatty acids are the active substance in the oils. Commercial oils have a stronger inhibitory action, as they contain free fatty acids, but neutral oils also possess this action, though in a less degree. Moreover, the action of neutral oils is slower. The inhibiting action of oils introduced into the rectum consists only in decreasing the quantity of gastric juice; its acidity and pepsin content remain nearly constant.

Mosquitoes and Coconut Palms. A Mosquito Survey of Palm Trees in East Africa and the Problems Resulting Therefrom (W. E. Haworth, *Trans. Roy. Soc. of Tropical Medicine and Hygiene*, October, 1924).—Mosquitoes breed in the crowns of coconut palms. Breeding goes on there with considerable regularity throughout the year, not merely when other potential hatcheries, derived from heavy rainfall, are in existence, but also during times of comparative drought when collections of storm water have subsided, and that in steps in the palms and in rot-holes in other trees has disappeared by evaporation. Within the township areas, in which almost the whole of the investigation was conducted, harmless jungle mosquitoes are in a decided minority, the vast majority of those got from the crowns of the palms being biting mosquitoes, and of these, at all stations, the proved disease carriers predominated. The species most plentiful was not the same at all stations: at Tanga it was *Culex fatigans*: at Dar-es-Salaam it was *Aëdes argenteus*. Until investigation settles the point there appears no reason for concluding that in some places species of *Anopheles* may not

be the most prevalent. Breeding taking place in them at all times of the year, the crowns of the palms act as reservoirs, from which may be stocked other suitable places, whenever such may appear from rainfall or other causes. Imagines are produced in sufficient numbers to prejudice the health of the community. The observations made and facts recorded do not enable the writer to fix a definite figure as the average output per palm per day; but from what has been done and set out, it is considered that it can scarcely be reasonably taken as less than one, and is probably very much higher. The minimum figure does not appear formidable when regarding a solitary palm for a single day, but even it assumes a menacing aspect when—realizing that the life of an imago may extend over many months—it is applied for every day of the year to a township area containing from 4,000 to 70,000 coconut palms.

What has been demonstrated for a portion of the east coast of Africa is probably also taking place throughout tropical lands round the world, wherever the coconut palm flourishes, varying in degree as the conditions may be more or less favourable to the palm, and in species yielded according to their geographical distribution. No antimosquito campaign can be considered otherwise than wanting in thoroughness which neglects to take account of the crown of the palm, since, although it may be found uninhabited, it must ever remain a potential nursery for disease-bearing pests. The natural enemies of the mosquito in all its stages, so far as observed, are inefficient; the harmful species have been found developing from the larval stage to the perfect insect in the presence of *M. brevipalpis* and *L. tigripes* larvæ; and *Aëdes* larvæ have been brought from crowns, the resting places of numerous bats.

Four New Cases of Mycetoma in Tunisia (Ch. Anderson, *Arch. de l'Institut Pasteur de Tunis*, Tome xiv, No. 1, 1925).—These four cases of mycetoma bring the number observed in Tunis up to sixteen. One of the cases here described was due to *Scedosporium apiospermum*, and the other three to a *Discomyces*. The first is the only case of its kind observed in Tunis.

Current Literature.

Bulletin de la Société de Pathologie Exotique.

February 11, 1925.

The Protozoa in Intestinal Intoxication (M. Castex and D. J. Greenway).—614 cases of intestinal toxæmia have been studied clinically and parasitologically by the authors. Protozoa were found in the stools of 415 of these; in 24 other cases protozoa associated with other parasites were seen. *Blastocystis hominis* comes first in order of frequency, followed by *Entamœba histolytica*, *Chilomastix mesnili*, and fourthly *Giardia intestinalis*. Helminthous infections were rare. Clinical symptoms differed in each patient. Investigations prove that intestinal protozoa are an important ætiological factor in chronic intestinal toxæmia. Stovarsol Poulenc and Yatren 105 Behring have given the best results as regards treatment, but are not equally well tolerated by all the patients.

Intestinal Protozoa of Man during the Epidemics of Petrograd (1919•1921) (W. L. Yakimoff and Mlle. W. J. Wassilewsky).—These researches were carried out with stools of patients during the epidemic of cholera and dysentery at Petrograd 1919, dysentery 1920, and cholera and dysentery 1921. The percentages of positive findings of parasites were high, the highest being of *Entamœba coli*. Cases of pure infection in 1919 numbered 27, in 1920, 104; and in 1921, 19. Mixed infections during these years were 36, 95 and 22 respectively. Descriptions of cases are given.

Apropos the Pig Louse: the Pig as Elective Host of Human Lice (P. Delanoe).—Parasitism of the pig by human lice was first reported by Bishopp (1915) in the United States. Pigs are very favourable to the multiplication of human lice; this is easily seen in any pig-sty in Morocco, where the lice are very numerous. They are of a jet-black colour and are thus easily perceptible. In one abandoned pig-sty seen by the author the ground was so thickly covered with lice that it seemed to be moving. Of a total of 1,001 lice taken in a pig-sty only two were dog-lice, all the rest belonged to the species *Pulex irritans* L.

Introduction of "Blue Tongue" in French West Africa (G. Curasson).—Up to the present this disease, which was prevalent in South Africa and carried off numerous victims every year, was unknown in French West Africa. Its appearance has apparently been brought about by imported South African sheep. The disease is more infectious than contagious; it is transmissible by inoculation.

Leprosy in New Caledonia, II. Course of the Disease in the Archipelago (G. Genevray).—Cases of leprosy have been recorded in the Archipelago since 1878, but statistics for the last ten years show there has been a great improvement and the numbers affected have decreased. Unfortunately, however, many cases of leprosy still exist, and everything possible is being done to exterminate the disease.

The Existence of Oriental Sore at Figuig (Eastern Morocco) (L. Leblanc).—A new site of oriental sore has been observed in Morocco; three typical cases are described. The insect incriminated as carrier of the disease is a spider. Although several places near Figuig have been infected some years, this is apparently the first time the disease has been noted there.

Third Note on Sheep Piroplasmosis in Algeria. The true Piroplasma (s. str.) ovis (nov. sp.) compared with Babesiella ovis (F. Lestoquard).—Investigations by the author show that two hæmatozoa exist in the Algerian sheep, belonging to two distinct subgenera: *Piroplasma* and *Babesiella*. Algerian sheep can be infected by five different viruses: *Piroplasma (s.s.) ovis*,

nov sp., *Babesiella ovis* (Babes, 1892), *Gonderia ovis* (Edm. Sergent, Parrot, Hilbert, 1922), *Theileria ovis* (Littlewood 1914), *Anaplasma ovis* (Lestoquard, 1924). The morphological and biological differences are described.

The Pathogenic Rôle of Chilomastix mesnili (M. R. Castex and D. J. Greenway).—From the literature it is seen that authorities on the subject of *Chilomastix* or *Tetramitus* do not agree with regard to the pathogenic properties of this parasite. By some it is considered the cause of colitis, others have attributed little importance to it, and recently cases of chronic diarrhœa presented the parasite in abundance in the fæces. The authors have found *Chilomastix mesnili* 118 times in 614 cases of chronic intestinal toxæmia; sometimes alone, at other times associated with protozoa and helminths. They are of the opinion that the *Chilomastix* in the forty-nine cases of pure infection was the pathogenic factor of the disease and the essential cause of different toxic syndromes.

The Pathogenic Rôle of Blastocystis hominis (M. R. Castex and D. J. Greenway).—*Blastomycystis hominis* is the parasite most frequently found in patients suffering from chronic enterogenous toxæmia. It is sometimes associated with other protozoa and helminths. It is the opinion of the authors that *Blastomycystis hominis* plays an important pathogenic rôle, both from a parasitologic and coprologic point of view, in many cases of enterogenous toxæmia. The *Blastocystis* is easily got rid of by means of Stovarsol Poulenc, and Yatren 105 Behring.

On the Subject of Blastomycosis (W. L. Yakimoff and W. J. Wassilewsky).—Investigations have been made in Russia with regard to the intestinal protozoa of man, 1919-1921, during which time *Blastocystis hominis* has been found 257 times in 1,632 stools examined. Of these cases 223 were pure infection, and 34 were associated with other parasites. Three cases are described in which diarrhœa was due to *Blastocystis hominis*.

The Isolation of the Pathogenic Agent of Blastomycosis of the Lacrimal Ducts (G. Jeaume and M. Dekester).—The organism isolated was named by M. H. Velu (1924) *Cryptococcus mirandei*. The authors have succeeded in making pure cultures on Sabouraud's gelose medium. The culture is rapid; a temperature of 30° F. seems to be the most favourable for its growth. The vitality of the fungus is very great in cultures; even when the cultures are old and have been abandoned for a year, reinoculation has given immediate results.

Correspondence.

To the Editor of the JOURNAL OF TROPICAL MEDICINE AND HYGIENE.

Sir,—I have received from Dr. J. A. Shaw-Mackenzie the following notes on a kennel not far from his home in the North of Scotland. In this kennel which he visited there appears to have been quite a number of cases of reputed cancer in dogs housed therein in the usual manner.

The kennel has been disused for several years on account of the "cancer" mortality among the dogs. As the kennel still remains unoccupied, it would certainly afford an opportunity for ascertaining the true nature of the disease if another dog could be housed for a time under the same conditions in the kennel and become similarly affected. The importance of investigation into incidents of this kind is obvious and the publication probably might bring to light similar experiences.—Yours truly,

W. J. SIMPSON.

31, *York Terrace*,
Regent's Park.
June 5, 1925.

REPORTED CANCER IN DOGS SUCCESSIVELY HOUSED IN THE SAME KENNEL.

The kennel is one of two, separated by a dividing wall and paling. The kennels are of the usual kind for sporting dogs. Each consists of outer court with concrete floor and central drain; and inner roofed division with sleeping shelf. The outside palings are wood on stone wall.

In only one of these kennels has the "cancer" been noted. The back of this kennel is an old wall of a shed which supports the roof of the sleeping compartment of the kennel. This is the only apparent difference in the kennels, the second healthy kennel having its own separate back wall and roof.

A great many dogs housed in the particular kennel have died or been destroyed for "cancer." Half a dozen at least were recalled to memory by the owner, including two retrievers, two or more spaniels and one pomeranian, which latter did not actually live in the kennel but was always about the particular kennel.

The cases have been noted over a long period, the last one a few years back, since when the kennel has not been used, owing to the natural unwillingness of the owner to expose any other of his dogs.

The duration before manifestation appeared to be about nine months.

In the female dogs the breast was affected, in one male dog, the penis, and in another the throat or larynx.

Previous to the last case the kennel was disinfected with lime, lysol and tar; and the floor taken up and re-concreted.

The cases were diagnosed by a well-known veterinary surgeon (since deceased). He had a great reputation in the North and was particularly interested in bacteriology. It is not known if he made any microscopic examinations of sections of the growths, or culture experiments. Whatever the nature of the disease there is no doubt of the successive mortality of the dogs housed in this particular kennel.

There appears to be nothing peculiar in the locality of the kennels.

The woodwork is old, noticeably worm-holed, and affected with dry rot.

In a neighbouring village there is a great deal of cancer, popularly associated with "dry rot."

Original Communications.

SOME REMARKS UPON *SPIROCHÆTA BRONCHIALIS* CASTELLANI, AND BRONCHIAL SPIROCHÆTOSIS.

By Lieutenant-Colonel FROILANO DE MELLO.

Director of the Bacteriological Laboratory, and Professor at the Medical College, Nova-Goa, Portuguese India.

INTRODUCTION.

THE disease which was discovered in Ceylon by Aldo Castellani and termed "bronchial spirochætosis," has also been found by several research workers in almost every part of the world. In all treatises, manuals of parasitology, or tropical pathology, reference has been made either to the disease itself or to its causative agent. For the last two or three years, however, as the area of the geographical distribution of bronchial spirochætosis has been found to be much more extensive than in former days, some scepticism seems to have arisen against what we have, up to now, considered to be based on well-established facts, and the objections which are intended to weaken the creation of this new chapter of human pathology can be combined in two principal groups: (*a*) those concerning the value of *Spirochæta bronchialis* as an independent species, and (*b*) those referring to the disease itself as a clinical and anatomopathological entity.

For the present, I will make some remarks founded chiefly on my own observations, showing the reason why my opinion favours the independence of the *Spirochæta* as a distinct species, as well as the autonomy of the disease as a clinical entity.

IDENTIFICATION OF SPIROCHÆTES.

Before entering on the subject of this paper, some facts must be considered in order to discuss the value of the methods employed by the protozoologists for the identification of spirochætes. A large number of these organisms cannot be cultivated, and *Spirochæta bronchialis*, as well as some of its allies, belongs to this group. If some blood and tissue-invading spirochætes can be differentiated by inoculation and by some immunity tests, the same cannot be done with species whose habitat is in open cavities of the body, together with a large and variable bacterial flora.

The movements of spirochætes vary to a large extent with the same species, according to various factors, viz., the temperature and chemical composition of the spirochæte-containing medium, the time elapsed after the material has left the infected body, &c.

The cytological study gives very little help for the specific characterization, and often various details of structure given as generic distinctions have been discovered further as belonging also to allied genera. Hence the tendency of certain protistologists to include all the species in two or three well-defined genera.

Under the circumstances, the only elements we possess for the identification of such spirochætes as I am discussing here are those concerning their morphological character. This point must be emphasized, and I fully agree with the following words of Scott Macfie, which still live fresh in my mind [1]: "For diagnostic purposes a morphological criterion is still urgently needed."

METHODS EMPLOYED BY THE WRITER FOR THE IDENTIFICATION AND CLASSIFICATION OF NON-CULTIVABLE SPIROCHÆTES.

The methods I employ at present for the specific determination of such non-cultivable spirochætes are strictly morphological and subordinate to the following points [2]:—

(*a*) A detailed cytological study of the parasite on smears stained, with and without wet fixation, by various dyes in order to let us know the colour reactions and the structure of the spirochæte; (*b*) the length of the spirochæte taken on at least 100 individuals drawn at camera lucida in order to know not only the maximum and minimum length, but also the percentages of the variations comprised between these extremes; (*c*) the number of coils taken on the same 100 individuals and disposed of in the same way; (*d*) the diameter (= breadth taken on stained slides, noting always the stain used for this purpose, as the breadth varies largely according to the chemical composition of the stain: thus the spirochæte seems narrower with Romanowsky than with phenicated solutions (when on a slide such as from dental parasites, there appear to be many species of spirochætes, the breadth is an important element for a primary differentiation of the species); (*e*) the ratio: length divided by number of coils, taken on the average of these elements from all the spirochætes drawn using the camera lucida, or more simply by dividing the total length by the sum of the number of coils of these 100 spirochætes. This ratio, which replaces with more efficiency the so-called average dimensions of spirals given by some authors for some spirochætes, has been named in my studies as the "index of morphological identification."

HOW I CAME TO USE FOR DIAGNOSTIC PURPOSES THE INDEX OF MORPHOLOGICAL IDENTIFICATION.

By a careful study of the spirochætes of the dental region in Portuguese India, I have seen [3]:

(1) That the spirochætes constitute the normal fauna of all the mouths examined.

(2) That their number increases enormously in cases of pyorrhœa alveolaris—a disease very common in this country.

(3) That these spirochætes can be divided at first into two groups:

(*A*) Those having a breadth from 0·4 to 0·8, even 0·9 micron, with large spirals, and whose number seems to be in a constant relation with the length of the spirochæte.

(*B*) Those with a breadth from 0·2 to 0·5 micron, having narrow spirals and whose number seems to be also in constant relation with the length of the spirochæte.

A careful study in a large number of cases showed me that these characters were found in every one, and that with the spirochætes of group *A*, the relation referred to above was equal or above to 2, and that with spirochætes of group *B* it was subject to oscillations varying from 1 to 1·33, being always below to 1·50.

The first spirochæte is the *S. buccalis* Cohn; the second, *S. dentium* Koch.

Ever since we described these elements in the morphology of the spirochætes, and in the description of *S. bronchialis* found in two cases of Oporto and Braga (Portugal), we have pointed out the following, besides the structure, forms of division, &c.: that the breadth on wet slides fixed by Bouin, Flemming, and sublimate alcohol and stained by Heidenhain's iron hæmatoxylin, was from 0·15 to 0·35 micron, and that on slides fixed by heat and stained by carbol fuchsin the breadth was from 0·25 to 0·45; minimum length 4, maximum 18 to 20; the majority (85%) between 5 and 12; minimum number of spirals 2, maximum 12. Ratio (length divided by number of coils) was 1·63 in the first case, 1·18 in the second case. As the ratio was so different in both cases, a question arose as to whether this element could be made use of as in the case of the spirochæte of the mouth for the identification of *S. bronchialis*. Evidently, a settlement of this point would necessitate further study, which would determine the same ratio in many cases of *S. bronchialis* in order to certify if it was its polymorphism that accounted for the variation [4].

Can these Methods be Employed for the Identification of other Species of Non-cultivable Spirochætes?

In Angola, having a large material for such studies, I intended to decide if the methods I tried on mouth spirochætes had any value for the identification of other species of non-cultivable spirochætes [5].

I identified the following spirochætes of the mouth in natives of Angola: *S. buccalis*: breadth 0·5 to 0·8, to even 1 micron; sometimes rudimentary undulant membrane; length, minimum 5, maximum 18, majority (72%) between 10-15. Number of coils, minimum 3, maximum 14, majority (85%) between 4-7. Ratio (length divided by number of coils) 2 (2·24). *S. dentium*, breadth 0·20 to 0·40, no trace of undulant membrane. Length, minimum 5, maximum 16, majority (89%) between 6-12. Number of coils, minimum 4, maximum 15, majority (91%) between 6-11. Ratio (length divided by number of coils) 1·4.

I found also two intermediary types, from which Type II was considered as a thinner variety of *S. buccalis*, and Type I as an intermediate. The following table shows the morphological characters: —

Mouth Spirochætes in Natives in Angola.
(Measurements in microns).

Species	Breadth	Minimum	Maximum	Majority	Minimum	Maximum	Majority	Ratio (index)
buccalis	0·5 to 1	5	18	72 per cent.—10-15	3	14	85 per cent.—4-7	2·24
dentium	0·2 to 0·4	5	16	89 per cent.—6-12	4	15	91 per cent.—6-11	1·4
intermedium (type I)	0·4 to 0·7	5	23	72 per cent.—8-15	4	16	83 per cent.—5-11	1·49
Var. *buccalis* (type II)	0·2 to 0·4	4	26	72 per cent.—8-15	2	11	86 per cent.—3-7	2·3

The same methods applied to intestinal spirochætes gave me the opportunity of identifying the organisms of *Eurygyrata* type with the following characteristics:—

Intestinal Spirochætes of Eurygyrata Type in Man and Animals in Angola.

Species	Breadth	Length* Min.	Length* Max.	Majority	Number of coils Min.	Number of coils Max.	Majority	Ratio (index)
Man	0·20	3	11	80 per cent.—4-7	2	11	87 per cent.—3-7	0·9 to 1·2
Horse	0·2 to 0·4	4	11	92 per cent.—4-8	3	7	92 per cent.—3-6	1·4
Mule	0·2 to 0·4	4	12	93 per cent.—6-11	3	8	87 per cent.—3-6	1·7
Guinea-pig	0·2 to 0·4	3	10	88 per cent.—4-8	2	6	96 per cent.—3-6	1·58
Rabbit	0·2 to 0·4	3	10	98 per cent.—5-8	2	7	98 per cent.—3-6	1·3
Ox	0·3 to 0·7	4	15	74 per cent.—5-10	3	10	90 per cent.—4-8	1·4
Goat	0·25 to 0·40	4	15	90 per cent.—5-10	3	14	79 per cent.—5-9	0·96
Sheep	0·25 to 0·40	3	14	89 per cent.—5-10	2	8	91 per cent.—3-6	1·7
Cat	0·25 to 0·50	3	10	88 per cent.—5-8	2	7	96 per cent.—3-6	1·4
Dog	?	4	13	94 per cent.—5-10	3	9	86 per cent.—3-6	1·3
Pig	?	3	10	85 per cent.—5-8	2	7	84 per cent.—3-5	1·6

* In one case a large type belonging to an animal type, possibly goat.

In conclusion, I think that the morphological methods are useful for the identification of non-cultivable spirochætes and that the ratio (length divided by number of coils), termed by me the *index of morphological identification*, gives a valuable element, much more advantageous than the so-called average dimension of the spirals formerly cited.

Morphological Characters of the S. bronchialis Castellani.

A very careful study of the *S. bronchialis* in six cases of broncho-spirochætosis in Portuguese India has given me the following elements [6]: (*a*) in

hanging-drop active movements of the progression on both extremities; helicoidal movements; frequent lysis; (*b*) in stained slides: well stained by aniline dyes, less, however, than the mouth spirochætes, especially of *buccalis* and *intermedium* type; breadth 0·2 to 0·6, with carbol fuchsin or phenicated gentian violet. No peculiarities on the structure: ends generally pointed, very rarely a rudimentary undulant membrane, visible only on the coils, room-chambered structure, transverse division, coccoid bodies.

The lengths and the number of coils are given in the table below:—

Another point which calls for attention is that I cannot accept as proved that all spirochætes found on phagædenic ulcers in association with fusiform bacilli are *ipso facto S. vincenti*. Having had a large material at my disposal in Angola, I have seen [7]: (*a*) that even in cases where there is only one species of spirochæte, I can morphologically identify at least two types:—

Type I.—Breadth, 0·40 to 0·70. Length, minimum 7 to 11; maximum 30 to 42; majority (74 to 84%) between 15 to 26. Number of coils, minimum 3; maximum 13 to 16; majority (81 to 94%) between 4 to 10. Index 2·6 to 2·7. This type is perhaps the same as *S. schaudinni* Prowazek, which I do not believe to be the same as *S. vincenti*.

Type II.—Same breadth; length, minimum 5 to 10; maximum 24 to 25; majority (73 to 83%) between 9 to 18. Number of coils, minimum 3, maximum 10, majority (83 to 84%) between 4 to 8. Index, 2·2 to 2·3. One or two flagella on each point.

(*b*) That in the majority of the ulcers there are more than one species of spirochætes, whose rôle, if pathogenic or saprophytic, cannot be found out by microscopic examination only. Only in two of these cases I found a type identical with a spirochæte met with in an undoubted case of Vincent's angina.

Type III.—Breadth, 0·25 to 0·40. Length, minimum 5 to 6; maximum 20 to 28; majority (67 to 75%) between 8 to 15. Number of coils, minimum 3 to 4; maximum 11 to 15; majority (79 to 80%) between 4 to 10. Index 1·4. However, this spirochæte cannot be considered absolutely pathogenic, as in ulcers having only one species of spirochæte I have sometimes found just the spirochæte that was in association with this Type III.

(*c*) In two cases Type II was found and in other cases the following types:—

Type IV.—Length, minimum 8 to 10; maximum 30 to 35; majority (68 to 81%) between 13 to 24. Number of coils, minimum 2, maximum 8 to 11; majority (75 to 88%) between 3 to 8. Index 3·0 to 3·7.

Type V.—Length, minimum 10, maximum 25; majority (61%) between 14 to 20. Number of coils, minimum 3, maximum 14, majority (78%) between 6 to 11. Index 2·1.

In conclusion, my opinion is that many species of spirochætes produce the so-called fuso-spirochætic symbioses in phagædenic ulcers, and that it is a mistake to identify all these spirochætes as *S. vincenti* on account of their association with fusiform bacilli.

MORPHOLOGICAL CASES OF S. BRONCHIALIS IN SIX CASES OF BRONCHO-SPIROCHÆTOSIS.

Case	Length			No. of coils			Index
	Minimum	Maximum	Majority	Minimum	Maximum	Majority	
I	5	24	80 per cent.—7 - 13	?	?	?	?
II	5	24	81 per cent.—7 - 13	3	10	81 per cent.—4 - 7	1·9
III	4	20	81 per cent.—6 - 11	2	11	95 per cent.—4 - 9	1·13
IV	4	19	80 per cent.—6 - 11	3	16	89 per cent.—4 - 10	1·2
V	6	19	80 per cent.—7 - 12	3	15	89 per cent.—4 - 10	1·36
VI	5	18	87 per cent.—7 - 12	4	12	92 per cent.—4 - 9	1·3

This leads me to define *S. bronchialis* with the following characters: extremities generally pointed, sometimes one blunt, breadth varying between 0·2 to 0·6 on slides stained by carbol fuchsin, length between 4 to 24 microns, and excepting some rare giant forms, the majority, or more than 75%, between 5-12 microns. Number of spirals varying between 3 to 18 and making the same restrictions for some rare, very long and narrow coiled forms, the majority, or 90%, showing 4 to 9 spirals. The ratio (length divided by number of coils) varies from 1·2 to 1·9, and the species shows a great polymorphism, possessing specimens of large and narrow spirals, which suggest the existence of perhaps more than one type or variety in this species. Cytological constitution is without special characteristics; some individuals show a rudimentary undulant membrane; room-chambered structure, transverse division; coccoid bodies.

Is S. BRONCHIALIS Identical with other Species of Spirochætes?

Some authors believe that *S. bronchialis* is not a valid species and must be identified with one of the following: (*a*) *S. vincenti;* (*b*) dental spirochætes.

(*a*) As regards *S. vincenti*, I must point out that the principal point in favour of the identification between *S. bronchialis* and *S. vincenti* is that *S. bronchialis* is at times associated in sputum with the fusiform bacillus, as in the case of Vincent's angina. The presence of the fusiform bacillus cannot be used for the diagnosis of different species of spirochætes, as many of them show the same association. The dental spirochætes, for example, are constantly seen together with fusiform bacilli, and in every case I examined, especially when there is pyorrhœa alveolaris, I have seen such association. Nobody would identify on account of this fact the dental spirochætes with *S. vincenti*.

Having discussed the value of this association for the purpose of specific diagnosis of spirochætes, I am obliged to state with Fantham [8] that little is known of the morphology of *S. vincenti*, a name given by Blanchard in 1906 without any description of the parasite. This name is, however, so widespread in the medical nomenclature as characterizing the agent of the well-known Vincent's angina, that it is our duty to describe it better, from well-defined cases of the above-mentioned disease.

Nowadays a protozoologist would be in serious difficulties to identify as *S. vincenti* a spirochæte found in fuso-spirochætic association, as the dimensions given for this species vary according to the authors (Castellani and Chalmers, 10 to 22 microns; Neveu Lemaire, *idem;* Brumpt, 5 to 12 in " Précis de Parasitologie "; 8 to 20/0·2 to 0·4 in Roger Widal, Teissier's " Treatise on Medicine "; Macfie quotes Bosanquet, giving 10 microns, Mackie noting even 40, Castellani and Chalmers 10 to 25, Fantham 9 to 23; Gonder 14 to 16, with 3 to 5 micron coils).

Only once have I been able to study a *S. vincenti* from a definite case of Vincent's angina. It had the following characters: Breadth, 0·25 to 0·75, showing in the last case a kind of undulant membrane. Pointed tips, rarely one blunt. Does not stain well with the common aniline dyes; stains violet pale with Romanowsky. Transverse division, binary and multiple. Coccoid bodies. Length. minimum 8, maximum 29, majority (75%) between 10 to 20. Number of coils, minimum 4, maximum 15, majority (85%) between 6 to 11. Index 1·5. Evidently it would be necessary to study many more clear cases of Vincent's angina to see the morphological variations to which the spirochæte is subject.

Based on therapeutic lines also, I have reasons to classify *S. vincenti* as a distinct species from *S. bronchialis*. Novarsenobenzol has given brilliant results in Vincent's angina and in the phagædenic ulcers, while on two of my patients with broncho-spirochætosis with hæmoptoic symptoms novarsan has proved absolutely useless, giving negative results both from clinical as well as from parasitological points of view (0·30, 0·45, 0·4, 0·60).

In conclusion, the identification between *S. bronchialis* and *S. vincenti* is far from being proved. The arguments I produce against this identification are: (1) *S. vincenti* is not well defined and the presence of *Bacillus fusiformis* cannot be used to characterize any species of spirochætes, as its association with many other species, even with common dental spirochætes, is constant; (2) the only definite *S. vincenti* I have seen stains weakly or not at all with common aniline stains in opposition to *S. bronchialis;* (3) novarsenobenzol, which gives so brilliant results on Vincent's angina and phagædenic ulcers, is without effect on *S. bronchialis*.

The opinion of some authors who consider *S. bronchialis* as a variety of *S. vincenti* is a mere hypothesis without any strong point to support it.

Some authors claim that *S. bronchialis* is one of the dental spirochætes. Indeed, there can be cases where the invasion of the ærial viæ by mouth spirochætes is possible, but two facts must be pointed out in connection with this hypothesis, when generalized, in order to demonstrate that *S. bronchialis* is from such an origin (I have already said that dental spirochætes stain more intensely and more easily than *S. bronchialis* with common aniline stains):—

(1) It is really curious that, when buccal spirochætes exist more or less abundantly in every mouth, only such an infinitely small percentage of persons suffer from bronchial spirochætosis. Certainly, I do not refer to some rare spirochætes found sometimes on a slide during the examination of the sputum for T.B. bacillus, and evidently coming from dental contamination. Broncho-spirochætosis is characterized generally by the presence of numerous spirochætes, and in spite of the fact that their number may be occasionally small, especially when the sputum is hæmoptoic, the spirochætes are seen in every microscopic field and their total number in a slide is far greater than the rare spirochætes found in ordinary sputum. (2) I have shown, dealing with *Intestinal human spirochætosis*, that mouth spirochætes may sometimes invade the intestinal tract and that they keep in the intestine their buccal characters [9]. So a comparison of *S. bronchialis* from a case with its own dental spirochætes will be full of interest. I have made this study completely in two cases, following my morphological methods; the summary is given in the following table:—

CASE IV.—COMPARISON OF S. BRONCHIALIS WITH MOUTH SPIROCHÆTES OF THE SAME CASE.

Species	Length Min.	Length Max.	Length Majority	Breadth	Number of coils Min.	Number of coils Max.	Number of coils Majority	Index
bronchialis	4	19	80 per cent.—6 - 11	0·2 to 0·5	3	16	89 per cent.—5 - 11	1·2
buccalis	5	25	73 per cent.—10 - 10	0·5 to 0·8	3	11	82 per cent.—4 - 6	2·78
dentium	5	18	76 per cent.—6 - 11	0·25 to 0·40	5	20	82 per cent.—6 - 11	1·02
Type *intermedium*	5	18	77 per cent.—7 - 13	0·4 to 0·8	4	13	84 per cent.—6 - 11	1·3

CASE V.

Species	Length Min.	Length Max.	Length Majority	Breadth	Number of coils Min.	Number of coils Max.	Number of coils Majority	Index
bronchialis	6	19	80 per cent.—7 - 12	0·2 to 0·5	3	15	89 per cent.—4 - 10	1·36
buccalis	6	19	89 per cent.—8 - 16	0·5 to 0·9	2	10	91 per cent.—4 - 7	2·1
dentium	5	16	79 per cent.—6 - 11	0·25 to 0·40	5	18	89 per cent.—7 - 13	0·87
Type *intermedium*	5	27	84 per cent.—8 - 15	0·4 to 0·8	3	19	84 per cent.—7 - 12	1·17

Before analysing these tables I must say that in Portuguese India, at least, the dental spirochætes are seen on a slide in the following comparative frequency: *buccalis, dentium, intermedium,* the last being comparatively rare. I take as *buccalis* the large spirochæte with large wavy spirals, *dentium* the narrow-coiled spirochæte, and *intermedium* the large narrow-coiled spirochæte.

Now analysing the tables, we can see that *S. bronchialis* can be immediately differentiated from *S. buccalis*. Certainly there are among specimens of *S. bronchialis* some large coiled forms, but I have never seen parasites with a breadth such as attained by *S. buccalis*, and I do not understand why the large forms would disappear in the bronchi.

S. bronchialis can also be differentiated from *S. dentium* on the above lines, being a more narrow-coiled species.

The differentiation with *S. intermedium* is more difficult, but besides the breadth of *S. intermedium* being greater than *S. bronchialis*, I must state that this dental species is less abundant than its two allies and that it can hardly be conceived why it should proliferate in the bronchi. For all these reasons I think that *S. bronchialis* is a distinct species, very polymorphous, possessing perhaps more than one type or species, which complicates the problem of its polymorphism.

Considering the disease from a clinical point of view, I must confess that anatomopathological data are wanting as well as many other elements corresponding to the principles of Koch-Henle's postulatum.

Many other well-defined diseases do not fully satisfy this postulatum, and it is not for these reasons that we are allowed to deny the autonomy of the broncho-spirochætosis. I will not refer to all clinical forms described by Castellani, but only to the chronic type on which I have sufficient experience. Clinical facts are and have always been most important, and all of us must recognize: (*a*) that, normally, the sputums practically do not contain spirochætes; (*b*) that in some cases the sputums show an enormous number of spirochætes.

The persons belonging to this second group show some alterations in their pulmonary apparatus, signs of bronchitis, some more or less inconstant râles, more or less hæmoptoic sputum. It is known to all of us that pathognomonic signs are not always found in pulmonary diseases, and I cannot certify that the various signs described by the authors in spirochætosis may not belong to some other associated causes; but what does not seem justifiable is the hypothesis that these spirochætes make their appearance on account of the blood existing in sputums: in cases of spirochætosis the agents are present, and sometimes in much larger number, even when the sputum is free from all blood; on the other side so many diseases with hæmoptoic sputums do not show any spirochætes at all.

Another point to be considered in these chronic patients is that they are subject to remittances on their clinical evolution, and it is just when the clinical signs reappear that the sputums show large quantities of spirochætes; hence, it is evident that a certain synchronism exists between the clinical evolution and the spirochætic discharge.

I am convinced that the disease discovered by Aldo Castellani is autonomous and that, if anatomopathological data are wanting, it is because the disease is not lethal and has not given occasion for full research work, in which the histopathology would certainly occupy the first place.

Before finishing, reference has to be made to two interesting publications in the literature at our disposal: a paper by R. Pons [10] and the book of Professor Delamare [11]. In the first paper the author states that in eight-tenths of the people at Saigon the dental spirochætic fauna is poor and in two-tenths very rich, owing certainly to carious teeth. His nine patients belong to the latter class. In Portuguese India the pyorrhœa alveolaris shows patients of the so-called rich fauna, and this disease is widely spread, as is shown by the following numbers: Children (3-12 years), 20% affected; young people (12-21) 56%; adults (over 21), 80%; native Christians, 83%; Hindus and Mohammedans, 80%; men, 80%; women, 30%.

The relative percentage of spirochætal infestation in normal and pyorrhœic persons can be appreciated by the following numbers (examination of 100 microscopic fields):—

Case	Normal per field	Pyorrhœa per field
I	0·34	93·41
II	0·31	111·42
III	0·47	89·18
IV	0·81	62·08
V	0·39	103·35

In spite of this large distribution of pyorrhœa, the cases of bronco-spirochætosis registered in Portuguese India since 1918 do not reach a dozen. Moreover, one of my last cases was found in a child where pyorrhœa alveolaris and its consequent rich fauna were not present.

As far as it concerns the distribution of the spirochætes in different parts of the mouth, my studies show that in the rhino-pharynx there are practically very few or no spirochætes, in the palate very few, their number increasing gradually as one approaches the dental region, which is the habitat *par excellence* of the spirochætes. The following numbers will give an idea of this distribution (100 microscopic fields):—

Case	Dental region	Saliva	Palate	Tonsils	Rhino-pharynx
I	21 spirochætes per field	6 spirochætes	0·01 spirochætes	0·01 spirochætes	0·02 spirochætes
	17 fusiform per field	2 fusiform	0·0 fusiform	0·03 fusiform	0·03 fusiform
II	16 spirochætes per field	6 spirochætes	0·02 spirochætes	0·19 spirochætes	0·05 spirochætes
	9 fusiform per field	5 fusiform	0·0 fusiform	0·07 fusiform	0·0 fusiform
III	31 spirochætes per field	5 spirochætes	0 01 spirochætes	0·05 spirochætes	0·04 spirochætes
	14 fusiform per field	3 fusiform	0·0 fusiform	0·07 fusiform	0·0 fusiform

I agree with Pons that disinfection by antiseptics does not decrease sensibly the rate of infestation of the different parts of the mouth, and it is recommended only to avoid particles retained in dental regions contaminating the sputum. Indeed, if the only passage of the sputum by mouth was enough to contaminate it with so many spirochætes as we see in that disease, I do not understand why every sputum sent for analysis should not show spirochætes, at least in such a large number as in pure saliva: we all know that among sputums sent for examination of Koch's bacillus, only a small percentage show a very minute rate of spirochætes that are certainly provenient from dental contamination. In my cases, distinction is very easily made between *S. bronchialis* and *S. buccalis;* some doubts may exist for the differentiation with other mouth species, especially with *S. intermedium*, but I hardly conceive how Pons obtained such a high index in three of his cases (2·56, 3·7, 4·1). His spirochætes must have been extraordinarily largely waved, and this fact will perhaps suggest new problems concerning the plurality of the types or species causing spirochætosis of the ærial viæ.

Professor Delamare in a very interesting communication shows that *S. bronchialis* can be morphologically differentiated from the common mouth spirochætes *S. buccalis* and *S. dentium*, the distinction being more difficult with *S. intermedium*. To his remarks I may be allowed to present some objections: (*a*) first of all, I do not find justification from a protistological point of view for the distinction he makes between *Spironema* and *Treponema*. The designation *Spironema* Vuill. 1906 is preoccupied by a fossil Gasteropod Meek 1864 and by a flagellate (*Spironema multiciliatum* Klebs 1892). Moreover, it seems that Delamare indicates under the name *Spironema* spirochætes of large waves, as he calls *Spironema buccalis* in contraposition with his narrow-coiled ally, which he designates as *Treponema dentium*. This sense, which the author employed also in designating the intestinal spirochætes [12], cannot be accepted, as we know that the term *Spironema* Vuill. was proposed for the spirochæte of syphilis, being in consequence synonymous of *Treponema*, whose type species is *T. pallidum*. (*b*) Stating that there are cases of pulmonary gangrene which evidently must not be regarded as broncho-spirochætosis of Castellani, Professor Delamare compares *S. bronchialis* with *S. vincenti*. The arguments pro and con can be resumed as follows: (1) absolute similarity of the majority of bronchial spirochætes with the spirochætes of Vincent's angina (Delamare). I will remark that in the only case of Vincent's angina I was able to study, the spirochætes did not stain well with common stains and required Romanowsky. The same happens with many types of spirochætes found in phagædenic ulcers. (2) Frequent symbiosis with fusiform bacillus (Delamare). I have already said that their association is found with many other spirochætes, even with common mouth species. (3) The absence of fusiform bacillus in some cases of broncho-spirochætosis does not necessarily indicate for Delamare that they are not present in the lesion, as occasional disappearances of and oscillations in their number have been observed. And it is on these arguments that Professor Delamare concludes that " il faut bien se décider á rayer *S. bronchialis* de la nomenclature," giving it a synonym of *S. vincenti*, constituting, perhaps, on account of its adaptation to the bronchi, a race particularly apt to be free of its habitual symbiosis with fusiform bacillus, and accepts the name *S. vincenti* var. *bronchialis*. It seems to me that this is a mere hypothesis unsupported by any solid reason.

For all these arguments I am of opinion that *S. bronchialis* Castellani is a distinct species and that broncho-spirochætosis is a clinical entity of its own.

Nova-Goa, April, 1925.

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FURTHER OBSERVATIONS ON VAGINAL MONILIAS AND VAGINAL MONILIASES.

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When microscopic examination is made of stained smear preparations of vaginal discharge, large round or oval bodies usually described as yeasts or yeast-like cells are frequently observed.

These are present in addition to an extensive bacterial flora which is always observed. As a rule the presence of these yeast-like bodies is straightway ignored on the presumption that they are of no clinical significance. Whether this presumption is justified or not yet remains to be proved. In the normal vaginal secretion they are present, if present at all, in extremely scanty numbers, being found neither in smears nor in cultures. On the other hand, they are often present in large numbers in cases of vaginitis associated either with an increased amount of vaginal secretion or with membrane formation.

Cultures of these organisms can readily be obtained by smearing a swab moistened with the vaginal discharge over the surface of a glucose-agar or a maltose-agar plate. By fishing and subculturing from the thick, creamy-white colonies that develop on the glucose-agar or the maltose-agar plates, pure cultures may be obtained without very great difficulty. Further study and investigation of the organisms so obtained shows them to belong to the genus *Monilia* Persoon 1797 of the class Fungi Imperfecti.

Under the name Fungi Imperfecti, Finckel gathered together all the forms of fungi, the complete history of which was unknown, and made this class in contradistinction to his other class of Fungi Perfecti, so that there is some ground for the naive remark of Lafar in his " Technical Mycology " that the Fungi Imperfecti are so called, not because the fungi in this group are themselves imperfect, but because our knowledge of them is imperfect.

They may be defined as follows: Fungi, almost invariably minute, but much larger than bacteria, in which asexual reproduction takes place by means of conidia produced on conidiophores which are either enclosed in perithecia, placed on discs, or unprotected.

The fungi thus defined were divided into two groups by Vuillemin, viz., the DEUTEROMYCETES and the HYPHALES. It is to the subclass Hyphales that the monilias belong, and the Hyphale of Vuillemin may be defined as Fungi Imperfecti with the hyphæ more or less developed, less or more or less compact, superficial or subsuperficial or more rarely as in man, vertebrates and insects, endoparasite conidiophores never situate in closed or open receptacles. Reproduction by means of spores isolated or in groups, situate on isolated or fasciculated hyphæ. The monilias are included in the family Oosporaceæ in the subclass Hyphales; and the relationship to the other genera of this family—the *Oospora* and the *Oidium*—is seen in the following classification:—

A. Hyphæ thin, short, simple, or nearly simple, terminating in chains of spores—*Oospora*, sugars not fermented with gas production.

B. Hyphæ not thin, often long and branched.

1. Sporophores simple and subsimple, typically with disjunction apparatus. Glucose completely fermented, gas being produced. Numerous budding forms in culture—*Monilia*.

II. Sporophores simple, septate, often with disjunction apparatus. Glucose not completely fermented, gas not being produced. Budding forms rare in culture—*Oidium*.

According to this classification the botanical definition of the monilias is as follows:—

Sporophores simple or subsimple, producing by constriction at their extremities a chain of large lemon-shaped conidia, often provided with a dis junction apparatus.

The usual definition, however, is as follows: Oosporaceæ, possessing *in situ* budding forms and mycelial threads, which later are often long and branched; in cultures mostly budding forms but sometimes filaments in which thallospores of the blastophore type are found. Glucose and often other carbohydrate media are fermented with the production of gas.

Very closely allied to, and at present often included in this genus are the *Zymonema* of de Buermann and Gougerot, 1909, including the *Zymonema gilchristi*, more commonly called *Cryptococcus gilchristi*, which causes American blastomycosis, the *Parasaccharomyces* of de Buermann and Gougerot, 1909, and the *Parendomyces* of Querat and Laroche, 1909.

The genus *Monilia* is widely distributed in nature, a number of species having been found growing on dead leaves, fruits and decomposing wood. That a number of species may affect man was first pointed out by Castellani, who has shown their importance as the ætiological agents of thrush, bronchomycosis (*pro parte*), and some dermatomycoses; whilst Ashford attributes the causation of sprue to a monilia—*Monilia psilosis*, which is probably merely a synonym of *Monilia enterica* Castellani.

The classification of the monilias has been the subject of much confusion. Morphological grounds do not suffice for a classification, but by means of their biochemical reactions a fairly satisfactory classification has now been reached. By means of the sugar reactions it is possible to divide the species of *Monilia* into groups: (1) by the use of the following carbohydrates: glucose, levulose, maltose, galactose, saccharose, lactose, inulin.

1. *Balcanica group.*—Gas produced in *glucose* only. *Monilia balcanica* Castellani. *Monilia parabalcanica* Castellani.
2. *Krusei group.*—Gas produced in *glucose* and *levulose*. *Monilia krusei*, Castellani. *Monilia parakrusei*, Castellani.
3. *Pinoyi group.*—Gas produced in *glucose*, *levulose*, *maltose*. *Monilia pinoyi* Castellani. *Monilia nabarroi* Castellani.
4. *Metalondinensis group.*—Gas produced in *glucose*, *levulose*, *maltose* and *galactose*. *Monilia metalondinensis* Castellani. *Monilia pseudometalondinensis* Castellani.
5. *Tropicalis group.*—Gas produced in *glucose*, *levulose*, *maltose*, *galactose* and *saccharose*. *Monilia tropicalis* Castellani. *Monilia partropicalis* Castellani. *Monilia pulmonalis* Castellani. *Monilia nivea* Castellani, *Monilia*

insolita Castellani. *Monilia enterica* Castellani.

6. *Guillermondi group.*—Gas produced in *glucose, levulose, saccharose* and *raffinose. Monilia guillermondi* Castellani. *Monilia pseudo-guillermondi.*
7. *Macedoniensis group.*—Gas produced in *glucose, levulose, galactose, saccharose* and *inulin. Monilia macedoniensis, Monilia macedoniensoides.*
8. *Pseudotropicalis group.*—Gas produced in *lactose* and *other carbohydrates. Monilia pseudotropicalis.*[1]
9. *Pseudolondinensis group.*—Gas produced in *dextrin* in addition to other carbohydrates. *Monilia pseudolondinensis* Castellani. *Monilia pseudolondinoides,* Castellani. *Monilia africana,* Macfie.
10. *Zeylanica group.*—No gas produced in any sugar.

In the vaginal discharge of cases of vaginitis, monilia belonging to groups *balcanica, pinoyi, metalondinensis* and *tropicalis* have been found in certain parts of the tropics, in the Balkans, in Italy and in England. More extended investigations will probably reveal other members of the genus in this condition. The members of Group 1 found were *Monilia balcanica* and *Monilia parabalcanica;* of Group 3, *Monilia pinoyi* and *Monilia nabarroi;* of Group 4, *Monilia metalondinensis;* and of Group 5, *tropicalis.* The principal characters of these organisms, together with other monilias, are set forth in the accompanying table.

In searching the literature we find several references to this subject; thus: Littauer described an aphthous vulvitis due to *Oidium albicans.* He believed that this condition begins as a primary vaginitis and is rarely found in children, but is common in diabetes and in the aged. He also mentions the cases of Plant in Hamburg, in which vaginal thrush and vaginal pruritis were associated with fungi of similar nature.

Von Herff has also recorded the occurrence of monilias in the vagina in cases of vaginitis and of vaginal pruritus, considering, however, that they were all comprised in the species *albicans* and *candida.* Loeser found saccharomyces among the microbic flora of the normal vagina and in cases with cervical catarrh with the formation of erosions, whereas Frank considers that in a perfectly healthy vagina only vaginal bacilli and comma variabile are found in the spread, and as the vagina approaches the pathological, more and more of the bacteria appear. Cases of vaginal thrush have also been described by Guilini, Hausmann, Vleemann, Mettenheimer and Panfilowicz.

TABLE I.—SHOWING CHARACTERS OF VARIOUS MONILIAS.

	Glucose	Levulose	Maltose	Galactose	Saccharose	Lactose	Mannite	Dulcite	Dextrin	Raffinose	Arabinose	Adonite	Inulin	Sorbite	Starch	Glycerine	Inosite	Salicine	Amygdalin	Inosondulcite	Erythryte	Gelatine	Serum	Litmus Milk	Colour of growth on glucose agar
Monilia zeylanica Castellani	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Yellowish
Monilia (cryptococcus) macroglossia Castellani ...	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	White
Monilia balcanica Castellani	G	G	O	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	White
Monilia parabalcanica Castellani	G	G	O	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	White
Monilia krusei Castellani	G	G	G	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	White
Monilia parakrusei Castellani	G	G	G	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	White
Monilia (cryptococcus) Castellanii Re ...	G	G	O	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Yellowish or brownish
Monilia pinoyi Castellani	G	G	G	O	O	O	O	O	O	O	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia nabarroi Castellani	G	G	G	O	O	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia metalondinensis Castellani... ...	G	G	G	G	O	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia pseudolondinensis Castellani ...	G	G	G	G	O	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia alba Castellani	G	G	G	G	O	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia pseudolondinoides Castellani ...	G	G	G	G	O	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia africana Macfie, 1921	G	G	G	O	G	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia albicans, Robin	G	G	G	G	G	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia tropicalis Castellani... ...	G	G	G	G	G	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Moniha metatropicalis Castellani	G	G	G	G	G	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia rhoi Castellani	G	G	O	G	G	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia guillermondi Castellani	G	G	O	G	G	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia macedoniensis Castellani	G	G	G	G	G	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White
Monilia macedoniensoides Castellani ...	G	G	O	G	G	O	O	O	G	G	O	O	G	O	O	O	O	O	O	O	O	O	O	O	White

[1] It is important to note that many monilias after a few transplantations lose some of their fermentative characters or these are altered. Hence the determination of species is possible only when using recently isolated strains.

in the first or membranous type, thrush-like patches of membrane are present on the mucosa (the so-called vaginal thrush); in the second or purulent type no such patches are present, but the secretion is thick and purulent. Where laboratory facilities do not exist cases of the purulent type of vaginal moniliasis are not rarely mistaken for gonorrhœa. The following illustrative case, which occurred in Ceylon, may be quoted: The surgeon in charge of the Colombo Lying-in Home had a case in which a pelvic operation was urgent; a thick purulent discharge was, however, noted, and active gonorrhœa was suspected, and he felt inclined to postpone the operation. A specimen of the discharge was sent to one of us for examination. No gonococci were found, but an enormous number of Gram-positive mycelial and conidial elements were present. Further investigation revealed the fungus to be *Monilia pinoyi*, Castellani.

Attention may also be directed to the presence of very numerous monilias in certain cases of chronic vaginal pruritus associated with muco-purulent discharge, although we cannot say whether the monilias really play a rôle in the causation of the pruritus. In these cases abundant irrigations of iodine (tinct. iodi ʒj, aq. ad Oij) have answered exceedingly well, especially after a preliminary short course of hot bicarbonate of soda irrigations. We might also call attention to a variety of pruritus vulvæ and pruritus ani described by one of us (C.), caused by localization of fungi of the genus *Epidermophyton* in the ano-perineal region and on the external surface of the labia majora, without any objective symptom pointing to an epidermophytic or trichophytic infection. In such cases the fungus remains dormant, and apart from the pruritus, give rise to no symptoms, although on close examination not rarely a few red patches may be seen. The condition may be compared to the pruritus interdigitalis pedium caused by the localization to the skin of the toes of the same epidermophyton. Fungi in that localization, too, remain dormant, causing pruritus but no objective sign pointing to an epidermophytic condition.

Recently we have come across a most interesting case of extremely severe pruritus ani, pruritus vulvæ and pruritus vaginæ in an elderly spinster, of some years' duration, which had been treated by different medical men in various ways without any distinct amelioration resulting. In the perianal region, on the perineum and on the labia majora a very few small reddish patches were seen, which it was thought might be due to a secondary pyogenic infection produced by scratching. There was an abundant purulent vaginal discharge and a very similar discharge from the anus, with symptoms of proctitis. A complete mycological and bacterial investigation was carried out, with the following results:—

1. From the scrapings of the perianal region and from the labia majora a fungus was grown with the characters of ***Epidermophyton cruris*** Castellani, 1905, the fungus which is the commonest cause of dhobie itch and pruritus interdigitalis pedium.

2. In the vaginal and in the rectal discharge enormous numbers of monilias were present, with very few bacilli; cultivations showed the fungus to be a strain of *Monilia pinoyi* Castellani.

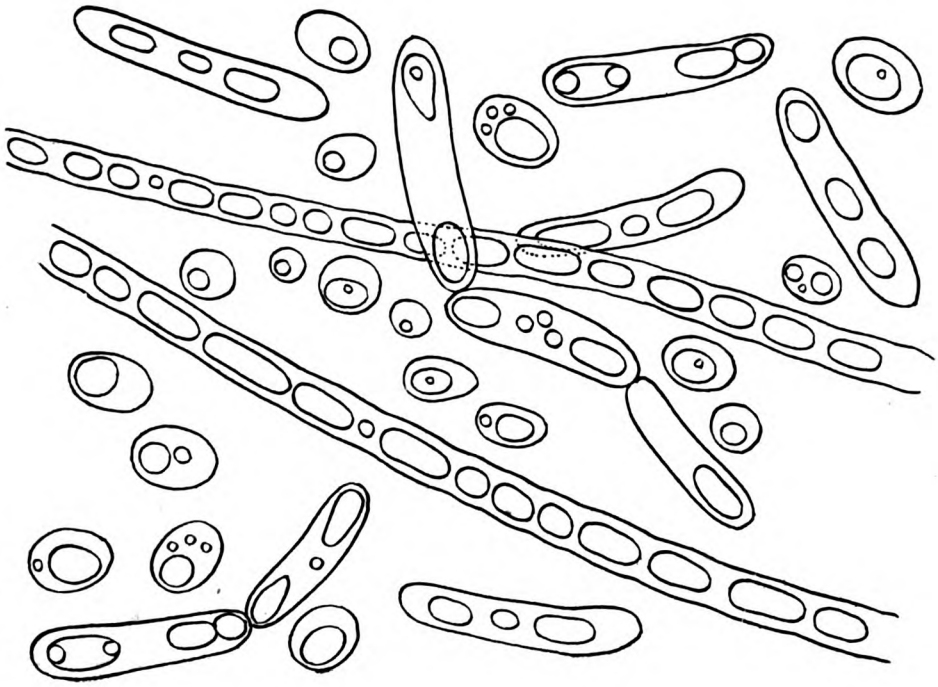
The following treatment was given: creosote was administered by the mouth. Tinct. iodi, which in this case did not give rise to any local pain or irritation, was freely applied once a day to the anal-perinal region, the perineum and the external surface of the labia majora. For the first three days hot alkaline irrigations (two ounces of bicarbonate of soda to two pints of hot water) were given; afterwards, twice a day with iodine irrigation (tinct. iodi ʒj, aq. ad Oij). Within two weeks the lady was completely free from the ano-perineal and vulvo-vaginal discharge, and the purulent rectal discharge had ceased entirely, whilst the vaginal discharge had decreased but had not quite disappeared. The monilias present had diminished enormously in number, but had not disappeared completely.

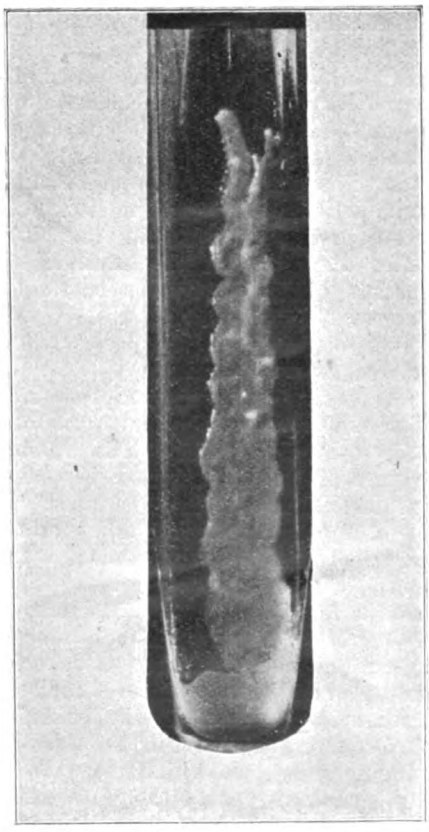
Monilias in the Identification of Certain Carbon Compounds.

Detection of Lactosuria.

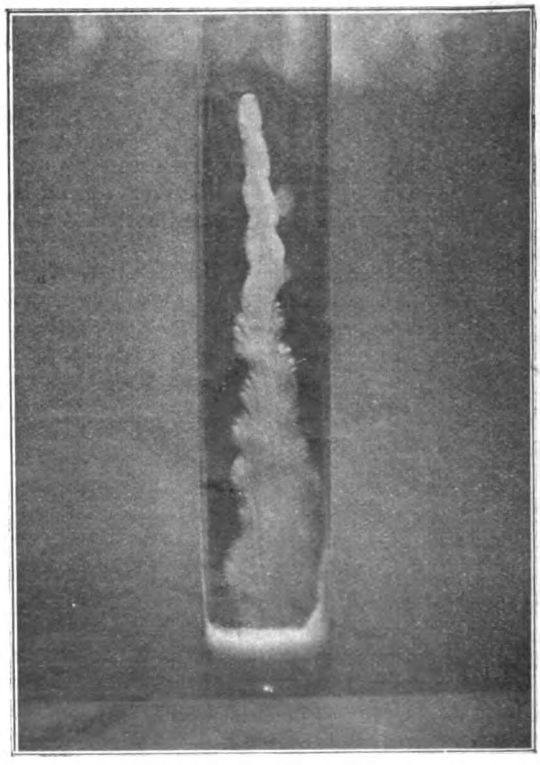
Certain species of monilia, some of which were isolated from the vagina, have been employed by us in association with other micro-organisms as reagents in a new method of mycological analysis of carbohydrates and other compounds of carbon, theoretically devised by one of us (C.) in Ceylon some years ago. The differentiation, for example, of the various Fehling-reducing substances present in urine is readily accomplished by the application of this mycological method. By its use we have been able to recognize the following carbohydrates in urine, viz., glucose, lactose, galactose, saccharose, maltose, pentose, glycerol and inosite. It forms a ready and convenient method for recognizing the presence of lactose in the urine of pregnant and puerperal women, and for differentiating this substance from glucose and other Fehling-reducing substances. The technique of the method may be found in papers published by us in the *British Medical Journal*, 1917, vol. xvi, No. 5. We will limit ourselves to describing very briefly the detection of lactosuria.

Lactose, as is well known, reduces Fehling's solution, and not infrequently lactosuria has been mistaken for true glycosuria. The detection of lactose by purely chemical methods is difficult for an ordinary medical man. In most textbooks it is stated that if a urine reduces Fehling and is not fermented by ordinary baker's yeast (so-called German yeast), the presumption is that the reducing substance is *lactose*. There are, however, two important sources of error. First, in our experience, quite a number of specimens of baker's yeast ferment lactose in addition to glucose, maltose, and other sugars; second, even if the baker's yeast should not ferment lactose this is not the only Fehling-reducing substance which may not be fermented by baker's yeast—the pentoses, for instance. If a urine which reduces Fehling is not fermented by ordinary yeast we cannot therefore





TUBE 1.—*Monilia Tropicalis* Castellani.

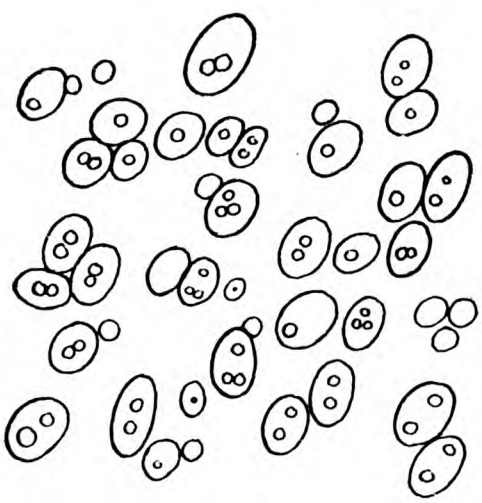


TUBE 2.—*Monilia Pinoyi* Castellani.

come to the conclusion that it is a case of lactosuria. Our mycological or myco-bacterial method, on the other hand, renders possible the detection of lactosuria in a very easy manner.

The urine is collected aseptically, or if this is not feasible, is distributed into sterile tubes (each containing a small fermentation tube) as soon as passed, and then sterilized in Koch's stove for thirty minutes on two or three consecutive days, or the urine may be filtered through a sterile Berkefeld filter. It should never be autoclaved, as this procedure not rarely alters the chemical structure of the sugars. Two or three tubes of the aseptic urine to which one-third or the same amount of sterile sugar-free peptone water has been added, are inoculated with certain monilias and other micro-organisms as follows:—

(*a*) No. 1 tube is inoculated with *Monilia pseudotropicalis*. No. 2 is inoculated with *Monilia tropicalis*. The two tubes are placed in the incubator at 37° C. for three days and then the results are read.



If No. 1 tube (*Monilia pseudotropicalis*) contains gas, and No. 2 (*Monilia tropicalis*) does not, we can come to the conclusion that in all probability the urine contains lactose. This is easily explained by keeping in mind the biochemical reactions of *Monilia tropicalis* and *Monilia pseudotropicalis*. These two monilias differ only in regard to lactose and maltose, *Monilia pseudotropicalis* fermenting maltose but not lactose; a substance, therefore, which is fermented by *Monilia tropicalis* must in all probability be *lactose*. This is represented by the following mycological formula:—

Monilia pseudotropicalis	+	= Lactose.
Monilia tropicalis	0	

(*b*) No. 1 tube is inoculated with *Bacillus neapolitanus* Emmerich. No. 2 tube is inoculated with *Bacillus pseudoasiaticus* Castellani. If after two days in the incubator at 37° C., No. 1 tube (*Bacillus neapolitanus*) contains gas and No. 2 tube does not contain gas, we can come to the conclusion that the urine contains lactose. The explanation lies in the fact that *Bacillus neapolitanus* and *Bacillus pseudoasiaticus* differ only in lactose as regards sugars and other carbohydrates found in pathological urines.

B. neapolitanus	+	= Lactose.
B. pseudoasiaticus	0	

(*c*) Tube 1 is inoculated with *Bacillus coli*, tube No. 2 with *Monilia metalondinensis*. If after 48 hours there is fermentation in No. 1 tube and no gas in No. 2 tube, we can come to the conclusion that lactose was present, provided Fehling was positive.

Fehling	+	
Monilia metalondinensis	0	= Lactose.
B. coli Escherich	+	

(*d*) In practice, the following procedure is very convenient. No. 1 tube is inoculated with *Bacillus coli* Escherich, No. 2 tube with *Bacillus paratyphosus* B Schottmüller. If fermentation occurs in tube No. 1 (*coli*) and does not occur in tube No. 2 (*paratyphosus*) we may come to the conclusion that the urine contained lactose, provided Fehling was positive. This is easily understood by remembering that *Bacillus coli* and *Bacillus paratyphosus*, besides lactose, differ in their action on raffinose and salicin, but raffinose and salicin are not Fehling-reducing.

Fehling	+	
B. coli Escherich	+	= Lactose.
B. paratyphosus B Schottmüller ...	0	

Further details on the method may be found in our publication in the *Annales de l'Institut Pasteur* (November, 1922).

Vaginitis associated with Fungi other than Monilias.

In addition to fungi of the genus *Monilia* Persoon, we may add that one of us (C.) has found occasionally in the vaginal secretion of native women suffering from very chronic vaginitis in the tropics, fungi of the genus *Oidium* (Link), *Aspergillus* (Micheli), *Sporotrichum* (Link), *Chladosporium* (Link), *Sterigmatocystis* (Cramer), *Cryptococcus* (Kützing, 1883), *Willia* (Hansen), *Vibriothrix* (Castellani), and others. Recently we have observed two such cases in European women in England, in one of which an aspergillus was grown, in the other a hemispora.

Vaginal Aspergillomycosis.—The case observed was an old woman, who complained of brownish-black vaginal discharge. The microscopical cultural examination revealed the presence of an aspergillus very similar to *Aspergillus fumigatus*. Irrigations with a weak solution of lysol cured the condition.

Vaginal Hemisporosis.—A young married lady contracted in the East a mycosis of the tonsils which, during the acute stage, was at first considered to be diphtheria. After the acute symptoms disappeared a greyish-whitish patch remained on the right tonsil. When she came to see one of

us in London, on her return from the tropics, she had had it for five months. She was complaining also of feeling discomfort in the vulva. The examination of her genital organs revealed a greyish patch on the inner surface of the right labium, somewhat similar to that present on the tonsil. From both the patch on the tonsil and the patch on the right labium a fungus was grown with all the characters of *Hemispora rugosa*. Local application of diluted tincture of iodine cured the condition, both on the tonsil and the labium.

Hemispora rugosa Castellani belongs to the Hemisporales Vuillemin 1910, the definition of which is Hyphales, with the mycelium, composed of abundant hyphæ, thin, but more than one micron in diameter, septate and



Hemispora rugosa.

branched conidiophores ramified basally, each branch terminating in a protoconidium, preceded by a constriction produced by a brown, rigid thickening of the wall. The protoconidium is transformed completely or partially into deuteroconidia, but occasionally it elongates, forming a new conidiophore, or puts out branches which are capable of becoming conidiophores. As regards classification, there is only one genus, *Hemispora* Vuillemin, 1906, the definition of which is mycelial filaments, thin, hyaline, septated, ramified. Each conidiophore terminates into an ampulliform structure (protoconidium), which later divides into several spore-like segments (deuteroconidia). Three species are known: *Hemispora stellata* Vuillemin, *Hemispora rugosa* Castellani, *Hemispora pararugosa* Castellani, Douglas and Thompson. The latter is probably only a variety of *H. rugosa*.

HEMISPORA RUGOSA.

Name of fungus	Motility Gram	Gelatine	Serum	Litmus milk	Lactose	Saccharose	Dulcite	Mannite	Glucose	Maltose
Hemispora rugosa Castellani ...	O	O	O	O	O	O	O	O	A	As
	+	+vs	O	O	O	Avs	O	O	As	As
		O	O	O	O	O	O	O	As	Avs
			O	O	O	Avs or O	O	O		O or Avs

Name of fungus	Dextrin	Raffinose	Arabinose	Adonite	Inulin	Starch	Salicin	Levulose	Galactose	Glycerine
Hemispora rugosa Castellani	O	O	As	O	O	O	O	O or Avs	O	O
	O	O	Avs	O	O	O	O	Avs	O	O
	O	O	Avs	O	O	O	O	O	O	O

Abbreviations used in the Tables.—A = acid; C = clot; G = gas; S = slight; vs = very slight; O = negative result, viz., non-production of acid or gas in

Hemispora rugosa Castellani, 1910 (*Syn. Monilia rugosa* Castellani, 1910.)

Definition.—Hemispora growing on all ordinary media, with a crinkled surface without asteroid colonies.

Remarks.—The growth on glucose agar is abundant, crinkled, or at times somewhat cerebriform; and in colour is amber, yellow, or brownish. Grows well on gelatine, which it liquefies very slowly, so much so that at first it was believed to be a non-liquefier. Gram-positive. Milk is not changed as a rule, but occasionally it undergoes a certain degree of peptonization, with a very small coagulum at the bottom of the tube. For sugar reactions see the table.

Hemispora pararugosa Castellani, Douglas and Thompson differs from *H. rugosa* in being a rapid liquefier of gelatine. *Hemispora stellata* Vuillemin is characterized by its asteroid colonies, and moreover, after a time glucose agar cultures develop a black pigmentation.

Conclusions.

1. In the normal vagina monilias and other fungi appear to be constantly absent.

2. In certain cases of vaginitis, vulvo-vaginitis, and of vulval vaginal and ani-perineal pruritus, monilias are abundantly present and may perhaps play some rôle in the ætiology of such cases, or at least produce the associated purulent or muco-purulent discharge.

3. Two principal types of vaginitis are associated with the presence of monilias, namely (*a*) the membranous type, presenting white patches of membrane on the vaginal mucosa, the so-called "vaginal thrush," and (*b*) the purulent type, with thick purulent vaginal discharge containing enormous numbers of monilias and sometimes simulating gonorrhœal infection.

4. Monilias, along with other micro-organisms, are employed in the authors' mycological method of identification of carbohydrates and other carbon compounds. This method is especially useful in the detection of lactosuria.

5. Attention is also directed to the presence of several genera of fungi other than the monilias in the vaginal secretion of cases of chronic vaginitis. A case of vaginal aspergillomycosis and a case of vulvar hemisporosis have been briefly described.

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THE CESTODE GENUS *HYDATIGERA* LAMARCK, 1816, SPECIES *REDITÆNIA* SAMBON, 1924.[1]

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and

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Sambon (1924, Journal of Tropical Medicine and Hygiene, 165) has recently proposed *Reditænia* as a new genus of Cestoda, with *Tænia tæniæformis* of cats as type species, and he differentiates the larval stage, *Cysticercus fasciolaris*, found in the liver of rats and mice, from other cysticerci under the new name *Strobilocercus*. The generic characters are:—

Tæniidæ, *Tæniinæ*: Rostellum massive, columnar, armed with double row of hooks and resembling an actinia (coral). Suckers prominent, set at base of rostellum and pointing forward and outward. Neck absent; segmentation begins immediately caudad of suckers. Adults in intestine of carnivorous mammals. Larva a "*Strobilocercus*" Sambon, 1924, J.T.M.H., 165 (i.e., a segmented cysticercus, in which the head is in the anterior end; bladder reduced, very small, at caudal end; body more or less segmented; the proglottids occasionally with genital primordia). Tod. *Tænia crassicollis* of cats (larva is *Cycticercus fasciolaris* of rats and mice).

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[1] Approved for publication by the Surgeon-General.

This newly proposed genus is of interest in human medicine from two points of view, namely:

(*a*) As parasites of man:—

I. *Tænia infantis* Bacigalupo, 1922 (*Semana med.*, 302-305, figs. 1-5), has recently been described as a new parasite of man in Argentine. It bears a remarkable resemblance to *T. tæniæformis* of cats, and if it is a valid species it is to be classified in the same genus with the tapeworm from the cat.

II. *Tænia crassicollis* Rudolphi, 1810a, is synonymous with *T. tæniæformis*. On account of a folk custom of eating chopped liver of mice in case of retention of urine, this worm has long been under suspicion as a possible parasite of man (but its occurrence in man is as yet doubtful).

(*b*) Because of the concurrence of cancer in the liver of rats with the presence of *Cysticercus fasciolaris*.

Whether or not the characters advanced by Sambon will be accepted as of generic value will depend largely upon individual conceptions of taxonomy. Conservatively they might be accepted as of subgeneric rather than of generic value, but admittedly this is a subjective opinion.

Attention may, however, be invited to the point that if *Tænia tæniæformis* is accepted as representing a genus or a subgenus distinct from *Tænia* (*Tænia*) type *T. solium*, and *Tænia* (*Tæniarhynchus*) type *T. saginata*, the new generic name *Reditænia* falls into synonymy, for it is antedated by two other names, *Megacephalos* and *Hydatigera*, both based upon the same species as genotype.

Megacephalos Goeze, 1782a, 42, was based upon the larval form *Tænia vesicularis fasciolata* (= *Cysticercus fasciolaris*) of the rat. The question arises, however, whether this name is available in nomenclature. The nomenclatorial practices of Goeze, 1782, are so confusing and subject to such subjective interpretation that the senior author of this paper circularized a number of helmintholo-gists about thirty years ago with the proposition that Goeze, 1782, be eliminated from consideration in nomenclature because of the inconsistencies. Several of Goeze's names had, however, become current, and the proposition did not meet with favourable response. Accordingly, he bowed to the view of the majority and accepted Goeze's names. To recognize *Megacephalos*, 1782, at present might produce confusion in other groups, the extent of which cannot be immediately foreseen. The following technical names of the same derivation have been proposed: *Megacephala* Latr., 1802, coleopt.; *Megacephala* Meig., 1824 (supergeneric), dipt.; *Megacephalidæ* Lap., 1834 (supergeneric), coleopt.; *Megacephalon* Temm., 1844, aves; *Megacephalon* Gray, 1846, aves; *Megacephalus* Fitz, 1843, rept. Partly on the basis of the principle that current nomenclature should not be disturbed unless the necessity therefore is clear under the International Code, and partly on the premise that we have grave misgivings as to the availability (under the International Rules) of Goeze's name *Megacephalos*, we are unwilling to assume the responsibility of accepting it.

Hydatigera Lamarck, 1816b, 153-154, was proposed to contain: (1) *Cystercus fasciolaris* of rodents, (2) *C. fistularis* of the horse, and (3) *C. cellulosæ* of man, &c. The first species, *C. fasciolaris*, was later definitely designated as genotype. *Hydatigera* is on a different basis from *Megacephalos*, and under Articles 25 and 26 of the International Code this name undoubtedly takes precedence over *Reditænia*.

The purpose of inviting attention to this point is to prevent, if possible, the use of the generic name *Reditænia* in medical literature with the certainty in view that it would have to be changed later. If the new taxonomic unit proposed is accepted by authors as of either generic or subgeneric value the correct name will be *Hydatigera*, with *Reditænia* as synonym.

NOTES ON NON-GONORRHŒAL URETHRITES.

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Very recently I was consulted by a planter on leave from an Eastern country, who informed me that he was suffering from chronic gonorrhœa, for which he said he had been treated with gonococcus vaccines without any benefit for a long period of time. On examination I found that there was a thick whitish discharge from the urethra. The microscopical examination showed absence of gonococci or of cocci and bacilli of any kind; instead numerous yeast-like cells were present; some glucose agar tubes were inoculated and a monilia was grown. I came to the conclusion that it was a case of mycotic urethritis, several types of which I described some years ago. I put him on creosote and potassium iodide and gave him also large doses of bicarbonate of soda; locally injections of mercury perchloride, 1 in 20,000, and instillations of diluted glycerine of borax on alternate days. All the symptoms disappeared within two weeks.

In connection with this case it may perhaps be of some interest to give a short general account of non-gonorrhœal urethrites, a subject which has hitherto attracted very little attention.

Some years ago I classified these conditions as follows:—

(1) Traumatic urethritis.

(2) Urethritis associated with protozoa.

(3) Urethritis associated with animal parasites higher than protozoa.

(4) Urethritis associated with fungi.

Another group of urethrites might be added; bacterial non-gonorrhœal urethrites, various cocci and diphtheroid bacilli having been described as capable of producing urethritis, but in my experience these organisms are usually secondary invaders.

Traumatic Urethritis.

In certain individuals prolonged marching or any other exercise or exposure to prolonged vibration, such as a long railway journey, seems to cause

symptoms of urethritis. One, of course, is rather sceptical in admitting such a type of urethritis, and practically all the cases of so-called "porter's urethritis" which I saw in Africa were cases of gonorrhœa. However, it must be admitted, in my experience, that in soldiers and porters doing long marches day after day, a slight urethritis with scanty mucous discharge, very seldom, if ever, purulent, may develop, even in individuals who apparently have never suffered in the past from gonorrhœa.

Urethritis associated with Protozoa.

The following varieties may be distinguished:—

(1) *Spirochætic Urethritis.*—This type of urethritis, first described by Macfie and due to *S. urethralis* Macfie, is occasionally met with. The discharge may be abundant and frankly purulent, and contain an enormous number of spirochætes. It must be noted, however, that spirochætes are not rarely found in the normal urethra, as shown by many observers and in the tropics by Mendelson.

(2) *Treponema Urethritis.*—The discharge is muco-purulent and contains a large number of treponemas (*Treponema urethrale* Castellani), without any cocci or bacilli. The organism is very delicate, stains purplish or pinkish, with Giemsa's, has numerous small spirals, all practically of the same size; length of the parasite 6 to 12 microns. The patient has no sign of syphilis and Wassermann is negative. Urethral irrigation of a 1 in 20,000 solution of hyd. perchlor. cures the condition. I have seen only two cases of this condition.

(3) *Urethritis associated with Amœbæ.*—Several cases have been recorded, the amœbæ being apparently of the *histolytica* type.

(4) *Urethritis associated with Flagellates.*—The flagellates found belong to the genera *Trichomonas* Donne, *Cercomonas* Dujardin, *Prowazekia* Hartmann and Chagas. It is doubtful, however, whether the flagellates found are the true ætiological agents of the discharge.

(5) *Urethritis associated with Ciliates.*—In a case of urethral discharge in a Singalese man in Ceylon, Chalmers and I found a *Balantidium*-like ciliate which we had previously observed in the vaginal secretion of several native women.

Urethritis associated with Animal Parasites higher than Protozoa.

These are generally due to larvæ of flies and chance parasites setting up an inflammation of the urethra.

Urethritis of Mycetic Origin.

Ætiologically these urethrites may be grouped as follows:—

(1) Associated with so-called *yeast-like* fungi, viz., fungi belonging to the genera *Saccharomyces* Meyen 1838; *Cryptococcus* Kützing 1833, *Monilia* Persoon 1797, *Endomyces* Rees 1870, and allied genera.

(2) Associated with fungi of the genus *Nocardia* Toni and Trevisan 1889.

(3) Associated with fungi of the genus *Oidium, sensu* Pinoy.

(4) Associated with fungi of the genus *Hemispora.*

(5) Associated with fungi of the genera *Aspergillus, Penicillium,* and allied genera.

(6) Associated with fungi of the genus *Cladosporium.*

(7) Associated with fungi which have not yet been classified.

The botanical description of these fungi may be found in the chapters on fungi in Castellani and Chalmers' "Manual of Tropical Medicine," third edition.

As regards the principal species of the genus *Monilia,* these are found in the paper on "Vaginal Moniliasis" by Taylor and myself in this number of the Journal.

In practice it is of advantage to use a clinical classification based on the colour of the discharge, viz.:—

(1) Mycotic urethrites with white or white-yellowish discharge.

(2) Mycotic urethrites with red discharge.

(3) Mycotic urethrites with black discharge.

Mycotic Urethrites with white or yellowish discharge.

Ætiologically two groups of cases may be distinguished: (*a*) those in which yeast-like organisms are found in the great majority; (*b*) those in which *Nocardia*-like fungi are present, very rare.

In cases of the first group, the fungi belong generally to the genera *Monilia, Saccharomyces* and *Cryptococcus;* the secretion is whitish or yellowish, generally scanty but occasionally abundant and macroscopically indistinguishable from gonorrhœal discharge. In certain cases signs of balano-posthitis due to the same fungi may be present, with or without thrush-like white membranes.

Cases of the second group, of *Nocardia* origin, are in my experience extremely rare. I have had two cases only: in both the discharge was yellowish, in one small yellowish granules composed of masses of bacillus-like fungus were present. *Nocardia* fungi were grown from both cases. I may add that potassium iodide given in large doses cured both cases.

Illustrative Case (mycotic urethritis with presence of yeast-like fungi).—In addition to the case I have mentioned in opening this paper, I could quote at least another half-dozen cases, but I will limit myself to saying a few words on a case I observed in the Balkans during the Great War:—

A young Serbian officer in Macedonia consulted me for a fairly abundant purulent urethral discharge. The patient was greatly distressed; he was engaged and believed he was suffering from gonorrhœa, though he denied having exposed himself to infection. I examined the secretion: no gonococci present; instead a large number of yeast-like cells and a few mycelial filaments could be seen. The cultural investigations showed presence

of a monilia very similar to *Monilia krusei*. I prescribed a mixture containing pot. iod., soda bicarb., glycer., syr. of tolu, and irrigations with a solution of perchloride of mercury 1 in 20,000. The discharge disappeared completely within ten days.

Mycotic Urethrites with black, greenish-black or brownish-black discharge.

The urethral discharge is black or greenish black or dark brownish, and may be very scanty; at times there is a yellow purulent discharge, in which small black or greenish-black granules are seen. The fungi found generally belong to the genera *Cladosporium*, *Aspergillus*, *Penicillium*, and closely allied genera. Very often, in addition to the fungi, various cocci and bacilli are found. In one case I grew a *Nocardia* producing a black pigmentation.

Illustrative Case.—An old Tamil coolie came to the Colombo Clinic in January, 1906, complaining of black urethral discharge dating from several months back. He stated that he had not had sexual contact for several years. The secretion was blackish and contained numerous small granules, which on microscopical examination were seen to consist of mycelian threads and spore-like bodies. Various sugar-media were inoculated and a fungus was grown, producing a black pigmentation, and very similar also in other characters to *Cladosporium mansoni* (Castellani). In two other clinically similar cases, one in a native and the other in a European, I found aspergillus-like fungi.

Mycotic Urethrites with red or pink discharge.

In these cases red pigment-producing fungi are found of the genera *Cryptococcus*, *Torula*, *Monilia*, *Saccharomyces*. At times two organisms are found; a higher fungus such as a monilia, living apparently in symbiosis with a red pigment-producing coccus or bacillus.

Illustrative Case.—A little Singalese boy, six years old, was brought to my clinic in Colombo by his parents because they believed he was passing blood from the urethra. The discharge, examined microscopically, consisted of leucocytes and numerous budding cells. Several sugar-agar tubes were inoculated and a red pigment-producing cryptococcus was grown. The child was given an alkaline mixture, and instillations of diluted glycerine of borax were carried out. This, however, did not improve the condition. Urethral injections of a solution of perchloride of mercury, 1 in 20,000, were then made, and a speedy cure resulted.

Primary and Secondary Mycotic Urethrites.

As is the case with so many other mycoses, the urethral fungoid infection may be *primary or secondary*. Practically all my cases seemed to be primary, but I observed once a monilial infection of the urethra developing in a case of chronic gleet.

RÉSUMÉ AND CONCLUSION.

(1) Non-gonorrhœal urethrites are not of frequent occurrence, but it would appear from my observations that they are not so exceedingly rare or non-existent as some authorities would seem inclined to believe.

(2) Non-gonorrhœal urethrites may be classified into three groups: (*a*) of traumatic origin, (*b*) of protozoal and metazoal origin, (*c*) of mycetic origin. Those of the first group are exceedingly rare and from a practical point of view may be omitted altogether; as regards the second group several of them are doubtful, the flagellates and some of the other protozoa found probably not being the true causative agents. The urethrites of the third group are the most important from a practical point of view, as there is little doubt that the fungi found are in a certain number of cases the true causative agents, but as is the case in so many other mycoses (bronchomycoses for instance) there is primary and secondary mycotic urethritis.

(3) Mycotic urethrites may be classified ætiologically according to the botanical position of the fungi observed or they may be classified clinically into three subgroups according to the colour of the discharge: mycotic urethrites with black discharge, mycotic urethrites with white-yellowish discharge, mycotic urethrites with red discharge. The urethrites of the first subgroup are generally associated with so-called yeast-like fungi (*Monilia*, *Cryptococcus*, *Saccharomyces*). Those of the second subgroup are mostly associated with the presence of *Cladosporium*, *Aspergillus* and *Penicillium* fungi; those of the third group with red pigment-producing yeast-like fungi or with apigmented yeast-like fungi together with red pigment-producing cocci and bacilli.

(4) Practically all the protozoa and fungi found in non-gonorrhœal urethritis of the male have been found also in cases of vaginitis and vulvo-vaginitis, and it is not, therefore, very improbable that in certain cases and under certain circumstances these affections may be transmitted by sexual intercourse, as I suggested some years ago.

The botanical description of these fungi may be found in the chapters on fungi in Castellani and Chalmers' "Manual of Tropical Medicine," third edition.

LITERATURE.

CASTELLANI (1920). Milroy Lectures, delivered before the Royal College of Physicians of London, *Lancet*.

The Therapy of Amœbic Dysentery (P. H. M. Travaglino and R. M. Soedjono, *Geneesk. Tijdschr. v. Nederl.-Indie*, vol. 64, No. 4, 1924).—The writers give their experience in about 359 cases among the population of a lunatic asylum in Java. Of the drugs administered yatren ranks the highest; emetine injections gave favourable results. Emetine bismuthius iodide was not so effective, but the dosage administered was only about one-seventh of the usual. Tannin injections were very painful. Cane-sugar enemas, ipecac. powder in salol-coated pills, bismuthous preparations *per os*, or simply diet and rest were not successful, nor were quinine enemas. A native drug called "setjang" appeared to give satisfactory results.

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JULY 1, 1925.

A WHITE AUSTRALIA: IS IT A POSSIBILITY?

By SYDNEY J. SKERTCHLEY, J.P.

(*Continued from page* 210.)

CHAPTER XV.

CONCLUSIONS.

The Four Great Principles Deduced from this Investigation.

I WILL now give a concise summary of the results of this investigation. Some of them may appear startling; some are new; all of them I believe to be profoundly important to the actual and prospective denizens of Australia.

(1) The course of human history has been reviewed from a novel standpoint: that of race, instead of that of politics. For this purpose the human species was dealt with on broad lines, as comprising the White, Yellow, and Black Races. The White Race was further subdivided into two sub-races—the Fair Whites and the Dark Whites. The former originated in the Baltic region, and are what are often called the Anglo-Saxon, or Germanic, stock. The latter are the swarthy folk of the Mediterranean area. It is with the Fair Whites—ourselves—we are chiefly concerned.

(2) The emigrations, immigrations, the conquests of these races, have been traced in broad outline. The evidence is abundant, and extends over thousands of years. It unmistakably points to a great law underlying the distribution of race. This law may be thus expressed:—

No race has ever permanently established itself on foreign soil.

(3) This conclusion, so directly contrary to the common view, is demonstrated over and over again. Thus, the Roman Empire was confined within ethnographic boundaries: the Rhine—Danube and the Tigris—Euphrates. Again, by the fifth century the Fair Whites had conquered all Europe and North Africa. They could not hold it, and their blood has vanished almost entirely from all but the native soil.

(4) This law involves a corollary. *The autochthonous blood tends to reassert itself and become again dominant.* Both these cases are illustrated by abundant evidence. Extermination alone prevents this rehabilitation of native races; but for us in Australia the matter is only of academic interest; our black-fellow is being exterminated.

(5) Another important law is also established. *Natural increase cannot be maintained by immigration.* The parent countries cannot stand a continuous drain of population; and Europe is now demonstrating this fact. The immigrants must multiply faster on the new soil than their predecessors die out, or the population does not naturally increase.

(6) The first tendency on a congenial soil is to raise the birth-rate above the normal, and to enhance the physique. After about three generations this impulse wastes itself; the birth-rate sinks below the normal, and the physique is impaired.

(7) Another highly important and unexpected law has been brought to light. *Improved conditions of life* (among immigrants) *do not raise the birth-rate; they only reduce the death-rate.* In other words, a child has a better chance of seeing old age, but more children are not born to enjoy this blessing.

(8) If this were not so we should find the birth-rate (and with it the natural increase) invariably raised as improved conditions made themselves felt. This is not the case. In the United States the natural increase is declining in an alarming manner. In Australia the decline is even more rapid.

(9) The conclusion which cries aloud from all the facts of history, and which must make itself heard, is that *it is almost impossible for any race to permanently occupy alien soil.*

(10) The fertility or healthiness of a country has little to do with its habitability by alien races. The United States, much of Asia, Australia, &c., are quite healthy; yet never has there been a case of permanent occupation by the whites, whether Fair or Dark.

(11) I said "almost" impossible. The one and

only possible exception is Canada, so far as time gives us sufficient grounds for coming to a definite conclusion. Australia (the truly extra-tropical part) may be another, but it is too soon to know, and *up to the present Australia is in a worse plight than the United States.* And in the United States the Fair White blood is rapidly dying out.

(12) The humid tropic land of Australia will never be truly colonized by white man, dark or fair, or all the history of every tropic land for four hundred years has no lesson for us. We may occupy it as overlords, we may be sojourners there for part of our lives, but we shall never work the land and live. We shall never bequeath our fee-simple to our heirs, for there will be no heirs to inherit.

(13) For the rest of Australia there may be hope; but hope can only lead to success if we intelligently and deliberately face the great problem of how to increase our rate of natural increase.

(14) We have traced two causes for the decline of our birth-rate; the abnormal aggregation in cities, and the severity of the woman's lot who "goes bush." Mitigate these evils and the birth-rate may be raised. Whether it can be so raised as to reverse the downward current that has so universally checked colonization time alone can show. I hope it is not mere hope that it may be so here in Australia. But the dream of a White Australia, as generally understood, is but a dream, and a foolish dream that is contradicted by every daylight fact from before the dawn of civilization to our year of jubilee.

(15) The facts and arguments I have set forth must be met fearlessly and intelligently; declamation will not alter them; political bias will not shift them a hair's-breadth, be they never so unsavoury to the palate. I have written in all seriousness after a long life of travel, observation and study. Let me close with the words of Cicero, now two thousand years old, words that will still be true two thousand years hence, when the question of a White Australia will have solved itself.

"History is the witness of the times, the torch of truth, the life of memory, the teacher of life, the messenger of antiquity."—*Or.*, ii, 15.

And again:—

"Who does not know that the primary law of history is that it should not dare to say anything false: next that it should dare to state the truth; that there should be no suspicion of favour nor yet of hatred in its words."—*Or.*, ii, 21.

And so I say sincerely and not unhopefully—

"ADVANCE AUSTRALIA."

THE END.

Annotations.

Autumn Stomatitis (H. Jamin, *Arch. de l'Institut Pasteur de Tunis*, Tome xiv, No. 1, 1924).—This condition is observed in a great number of the people in Tunis at the beginning of autumn, and occasionally at the beginning of spring. The patient complains of pain and a hot sensation of the buccal mucus, which is increased by movement of the tongue in speaking, and more still when food is taken into the mouth. The clinical picture is described. The whole mouth, gums, cheeks, &c., and tongue are covered with a light exanthema, and small red papules. The lesions of the mouth clear up before those of the tongue. Sometimes the tongue alone is affected.

Reinoculations in Infection due to a M. melitensis, especially after the Experimental Malady of the Guinea-pig (Et. Burnet, *Arch. de l'Institut Pasteur de Tunis*, Tome xiv, 1925).—Guinea-pigs infected with *M. melitensis* react to subcutaneous reinoculation by a thermic reaction. With peritoneal reinoculation they die, if the dose is strong enough, with formation of an abundant exudate and congestion of the abdominal organs, especially of the spleen and uterus. The reinoculation provokes a local reaction analogous to the phenomenon of Koch. In the case of *M. melitensis*, this reaction is characterized by the *abscess* more than by the necrosis. The phenomenon is less intense than in tuberculosis. In the reinoculation of *M. melitensis*, as in the reinoculation of tubercule bacilli, one can distinguish, in the "Koch phenomenon," the toxic reaction and the phenomenon of Arthus, although the two conditions are not quite independent of each other. In the guinea-pig infected with *M. melitensis* and reinoculated, the melitine reaction is more pronounced than the local reaction. The reinfections do not aggravate the *M. melitensis* infection; this should encourage trial of vaccinotherapy in Mediterranean fever. The microbes of reinoculation rapidly disappear from the organ already infected. They are not eliminated from the liver and the kidneys with the bile and urine; they are seized and destroyed by the phagocytes. The reactions of hypersensibility and the application which was made for the diagnosis, constitute a striking analogue between the melitococcus and tuberculosis.

On the Preservation of Marrow for Antirabic Treatment (Et. Burnet, *Arch. de l'Institut Pasteur de Tunis*, Tome xiv, No. 1, 1925).—The conclusions of this paper may be given as follows: Glycerine is universally used in the preparation of antirabic vaccine; but the preservation of the virulence of rabic marrow in glycerine is not unlimited. It is the rule, in antirabic institutes, not to use marrow which has been in glycerine, in the glaciere, more than 14 days. According to Remlinger, on account of the weakening of the virulence in the course of the passages, this limit of 14 days has become too much; it should be reduced to 8 days. The writer's investigations were carried out with Pasteur virus and maintained by passage, and with two days' marrow, preserved in glycerine in an ordinary glaciere. In glycerine, the shortest time of preservation observed was 20 days; virulence has also been observed after 27 and 62 days. Marrow whose virulence was preserved 20 days and up to 28 days killed the rabbit. Rabbits

have also been killed with marrow of 62 days' duration. On some media (olive-oil, &c.) marrow retains its virulence for a longer period, but these media cannot be used in antirabic treatment for reasons described. The duration of the preservation is not the same with all marrow; it depends on the richness of the virus. These results show that it is not necessary to change the limit of 14 days. Even with fixed virus having passed the 2,000th passage good results have been obtained in glycerine.

On Some Lesions of the Nervous System Provoked by Antirabic Injections (Dr. Pamboukis, *La Grèce Médicale*, December, 1924).—Cases have been recorded, since about 30 years ago, of complications ensuing the treatment for rabies. Two new interesting cases are described, the first a patient bitten by his dog in 1912. Fever set in after the seventh injection, and after the ninth he had spasms in the upper limbs; he had begun to feel numbness of the limbs after the third injection, which had increased the following days. Treatment was discontinued after the seventeenth injection as the symptoms were worse. The eighteenth day after the commencement of treatment the patient was suffering from facial paralysis and other severe symptoms. He was almost completely cured by electrical treatment of forty days' duration. Ten years later the same patient was bitten again, and paralysis of the right side of the face ensued the treatment; he was cured eventually without treatment. The second case, a lady, was bitten in 1922 on the hands and legs by a cat: two days later the cat bit this lady's daughter, who afterwards died. The mother was in a nervous state and often suffered from an intense cephalitis. After the fourteenth injection, she was attacked with this cephalitis and severe pains in the back of the neck and first thoracic vertebra. The pains got worse and after the sixteenth injection the treatment was stopped. The pains continued, however, and were insupportable. There was unilateral facial paralysis, which is a rare complication. The patient was eventually cured. This is probably the only case reported of polymyelitis with slight spinal meningitis.

The Histogenesis of the Hydatid Parasite (Tænia echinococcus) in the Pig (H. R. Dew, *The Medical Journal of Australia*, January 31, 1925).—This experimental study of the early stages of the development of the hydatid cyst leads to the following conclusions. The hydatid hexacanth embryo finds its way to the liver by means of the portal vein, and there is evidence to show that the liver barrier is by no means a perfect one. The time taken for the embryo to reach the liver is very short and sections show it in the liver lobules within twelve hours. The embryo tends to come to rest in the substance of the liver lobules and has a predilection for the subperitoneal lobules. By the local reaction of the liver tissue a hydatid follicle is rapidly produced. In the second week vesiculation commences. There is a very striking local eosinophile cellular accumulation and also much cellular reaction in the periportal zone, which brings this infestation into line with that of other helminths. There is evidence that in some cases the cellular reaction on the part of the host tissue overcomes the parasite in the earlier stages with the production of an aborted follicle. The adventitious capsule by organization becomes avascular and fuses intimately with the surrounding liver tissues. This fusion precludes any possibility of total enucleation of the whole cyst at operation. A remarkable feature is the persistency of patent biliary channels in the fibrous adventitia even close up to the parasite itself. This no doubt explains the frequency of complications in liver cysts due to the entry of bile and so forth. The cyst grows as a rule in a spherical form, but it also tends to take the line of least resistance so that pouching is not uncommon. This pouching is determined by the local resistance of bands of fibrous tissue, large blood-vessels or bile-ducts. At the end of five months the cyst may reach a diameter of one hundred millimetres, but there is no trace of the formation of blood capsules at this stage.

Studies in Scarlet Fever II. Studies on the Use of Convalescent Scarlet Fever Serum and Dochez' Scarlatinal Antistreptococcic Serum for the Treatment of Scarlet Fever (Konrad E. Birkhaug, *Bulletin of the Johns Hopkins Hospital*, February, 1925).—In the study of thirty-seven cases of scarlet fever treated by intramuscular injections of 15 to 85 c.c. of serum from convalescent cases of scarlet fever, it was found that:—Convalescent scarlet fever serum causes a rapid improvement in the general symptoms and a slight fall in temperature and pulse-rate, but produces no effect upon the general rash, and does not shorten the convalescence or reduce the incidence of septic complications during convalescence. A comparative study of thirty-one cases of scarlet fever showed that the intramuscular injection of Dochez' scarlatinal antistreptococcic serum in amounts of 40 c.c. administered during the first three days of the disease caused a prompt disappearance of the toxæmia, a critical fall in temperature and pulse-rate, prompt fading of the general exanthema, rapid reduction in leucocytosis and rapid disappearance of the glandular enlargement. The Schultz-Charlton rash extinction phenomenon can be obtained with samples of serum withdrawn from patients treated with Dochez' serum shortly after its injection. A therapeutic dose of 40 c.c. of Dochez' serum was sufficient to bring about a clinical cure in moderately severe cases of scarlet fever. The incidence of septic complication was low in the cases treated with Dochez' serum prior to the fourth day of the disease. The cases presenting septic complications yielded slowly and irregularly to Dochez' serum.

Alastrim (M. Brelet, *Gazette des Hôpitaux*, January, 1924).—Alastrim is an infectious, contagious and epidemic disease, its essential symptom is an eruption

very much like the exanthema of small-pox and chicken-pox. It chiefly attacks the black races, possibly because they have a greater receptivity and their conditions of living are unhygienic, rendering contagion easy. It is not known whether alastrim is contagious before the eruption appears, or the length of time that the disease is contagious, but in any case the matter of the vesico-pustules, the nasal mucus, the saliva and sputum must be considered as contagious. The symptoms of the disease are described by the author.

Investigations on Pulmonary Tuberculosis in Cochin China (Lasnet, *Bulletin de l'Office International d'Hygiene Publique*, January, 1925).—The writer gives the results of his investigations during the past two years in Cochin China. The form of tuberculosis most frequently seen is the pulmonary form, and the affection is carried from one person to another. Sero-diagnosis proved of great value. With the aid of the Government and the Service d'Hygiene of the Pasteur Institut of Saigon, general conditions have been improved and prophylactic measures carried out.

Abstract.

THE PROPHYLAXIS OF SLEEPING SICKNESS.[1]

By Professor EMILE BRUMPT.

SINCE the discovery of the sleeping sickness trypanosoma, by Castellani, and the hypothesis set forth by Sambon and myself on the transmission by tsetse flies, and the definite experiences of Bruce and Nabarro, of Kleine and of Tante, it is now possible to fight against the spread of sleeping sickness. Nevertheless, in spite of all efforts made till now, results obtained have not been very encouraging, because we do not know entirely yet which are the domestic and wild animals able to bear in their blood the two species of trypanosoma found in man. Sleeping sickness, so common in equatorial Africa, may only exist in an endemic or epidemic state if there are: (1) Sick people and infected animals; (2) glossinas or tsetse flies; (3) healthy people.

So, as in the case of malaria, we must study those various epidemiological elements during at least a whole year, in a determined region, before ordering effective prophylactic measure.

We shall examine first of all the reservoir of virus to appreciate the frequency of the disease. For this purpose, natives of the same village are gathered together and trypanosomes are sought for in blood smears and in the fluid extracted from enlarged lymphatic glands. This microscopical examination necessary to discover sick people at the first period, is useless later on, diagnosis being then evident. Enlargement of lymphatic glands is not so frequent as enlargement of spleen in malaria, for it misses sometimes in the case of sick people, and exists in healthy ones. That is why lymphatic puncture and microscopical examination are necessary. In those conditions, presence of trypanosomes allows us to maintain the diagnosis. When we have examined the greater part of the population of a region, we can establish: (1) The endemic index in each locality; (2) frequency of infection according to age, sex, occupation; (3) the relation between presence of trypanosomes in blood and enlarged lymphatic glands; (4) the relation between parasitical index and lymphatic index.

To complete the study of man's pathogenic trypanosomes in nature, it is necessary to look for them equally in the blood of domestic and of wild animals. Unfortunately till now this has never been entirely done, no differentiating test existing for animals' and man's trypanosomes. So all studies on that subject will not be of great value until it will be possible to do otherwise than to inoculate a virus into a receptive man, as has been done by scientists to themselves or to noble willing men.

We must study now the second element of endemicity, the *Glossina* of tsetse flies. It is by the knowledge of the glossina's biology that we may fight successfully against them. As in malaria, the measures are different according to each case. For instance, for a traveller having to cross endemic zones atoxyl preventive injections and protection from tsetse bite are the only things to be done, but in villages situated in regions swarming with glossinas, the surroundings must be deforested and the haunts destroyed. Fighting *Glossina morsitans* in savanahs by bush fires is not the same as fighting *Glossina palpalis* living in forest glades, to which it is impossible to set fire before cutting trees. After having deliberately chosen the most practical method, the difficulty consists in having measures executed and controlled. This is the affair of the Colonial Administration.

The principal administrative measures to take are:

Division of an unhealthy country into zones under the direction of a doctor with an auxiliary staff.

Compulsory declaration of disease by the native chiefs of villages.

Reconstitution and grouping of native villages in flyless regions.

The issue of sanitary passports.

Regulations made to prevent native travelling.

Creation of stations of inspection, or "filtrating stations" as we call them, where sick people are kept and nursed.

Improvement of the economic conditions of natives.

Work organization and inspection of workmanship undertaken by colonial societies.

Making the ground healthy by various processes.

All the European colonizing nations must participate, by scientific means and application of improved knowledge, in the eradication of this dreadful African plague, which commercial or military expeditions have contributed to spread from infected regions over healthy countries swarming with transmitting tsetse.

[1] Chadwick Public Lecture, Royal Society of Arts, John Street, Adelphi, London, May 29, 1925.

Original Communications.

NOTES ON MIXED MYCOTIC INFECTIONS OF THE BRONCHI. THE MIXED MONILIA + ANAEROMYCES INFECTION.

By Aldo Castellani, C.M.G., M.D., F.R.C.P.
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One of us, since 1905, has called attention to the comparative frequency of cases of subacute and chronic bronchitis, clinically simulating tuberculosis, but in reality due to totally different organisms: fungi, protozoa and worms. In previous publications we have described cases of broncho-moniliasis, broncho-oidiosis, broncho-hemisporosis, broncho-anaeromysis, occurring in England. In the present paper we propose to touch briefly upon the subject of mixed mycotic infections, in which probably two species of fungi, and not one only, play an ætiological rôle. We will limit ourselves in the present paper to discuss only one mycotic association: the monilia and anaeromyces association. It may, perhaps, be advisable to first say a few words on broncho-moniliasis and broncho-anaeromysis, although we have fully described these conditions in other publications.

Broncho-moniliasis.—This term is used to denote bronchial conditions associated with the presence of monilia fungi in the sputum. Three varieties of bronchial moniliasis may be distinguished:—

(1) Primary moniliasis.
(2) Secondary moniliasis.
(3) Saprophytic moniliasis.

In *primary broncho-moniliasis* the monilia is the actual causative agent of the condition: in *secondary broncho-moniliasis* the monilia is a secondary invader, like the streptococcus in pulmonary tuberculosis; in *saprophytic moniliasis* the monilia is merely a saprophyte with no pathogenic action whatever. In the case of true primary moniliasis, the monilia, isolated from the sputum, when injected intrapulmonarily into rabbits will produce a peculiar nodular condition of the lungs; in the case of secondary broncho-moniliasis, the monilia injected intrapulmonarily will not produce any nodular condition of the organ, but a general monilial septicæmia will ensue, and the rabbit will die within a few days, or be very ill. In the case of saprophytic moniliasis the intravenous and intrapulmonary injection of the isolated monilia will give rise to no symptoms whatever, and the rabbit will remain quite well.

Pathogenic monilias belong generally to the types *krusei*, *pinoyi*, *metalondinensis*, *tropicalis*. It must be noted that at times two monilias may have identical sugar reactions, but one is pathogenic to rabbits and guinea-pigs, and the other is not. According to Redaelli, the original strain of *Monilia krusei* Castellani, when inoculated intravenously into guinea-pigs, localizes itself only to the lungs, and at the post-mortem mycotic nodules are found only in these organs.

It must be noted also that a number of monilias, after several transplantations, lose some of their biochemical characteristics, and therefore their classification can be satisfactorily carried out only by using strains recently isolated. The biochemical reactions of certain monilias, however, are permanent; for instance, *Monilia krusei*, *Monilia tropicalis* and *Monilia macedoniensis*. We have strains of these three monilias several years old, and their sugar reactions have always been the same in regard to the production of gas, although the production of simple acidity may somewhat vary. As an example we may quote *Monilia krusei* Castellani. One of the strains we have is fourteen years old; it has always produced, and is still producing gas in glucose and levulose and no other carbohydrate, but occasionally may produce a slight acidity in maltose and galactose. In the classification of monilias at the present time, therefore, we take into consideration only the production or absence of gas.

Determination of Group and Species.—One of us some years ago suggested the following grouping of monilias, based on the action of these organisms on glucose, levulose, maltose, galactose, saccharose, inulin and dextrin.

Group I (*Monilia balcanica*). — Gas produced in *glucose only.*
Principal species: *M. balcanica*, *M. parabalcanica.*
Group II (*Monilia krusei*).—Gas produced in *glucose* and *levulose.*
Principal species: *M. krusei*, *M. parakrusei.*
Group III (*Monilia pinoyi*).—Gas produced in *glucose*, *levulose*, and *maltose.*
Principal species: *M. pinoyi*, *M. nabarroi.*
Group IV (*Monilia metalondinensis*). — Gas produced in *glucose*, *levulose*, *maltose*, and *galactose.*
Principal species: *M. metalondinensis*, *M. pseudometalondinensis*, *M. albicans* (clots milk and liquefies gelatine).
Group V (*Monilia tropicalis*).—Gas produced in *glucose*, *levulose*, *maltose*, *galactose*, and *saccharose.*
Principal species: *M. tropicalis*, *M. paratropicalis*, *M. pulmonalis*, *M. nivea*. *M. insolita*, *M. enterica.*
Group VI (*Monilia guillermondi*).—Gas produced in *glucose*, *levulose*, and *saccharose.*
Principal species: *M. guillermondi*, *M. pseudoguillermondi.*
Group VII (*Monilia guillermondi*).—Gas produced in *glucose*, *levulose*, *galactose*, *saccharose*, and *inulin.*
Principal species: *M. macedoniensis*, *M. macedoniensoides*, *M. chalmersi*, *M. parachalmersi.*
Group VIII (*Monilia pseudotropicalis*). — Gas produced in *lactose, in addition to other sugars.*
Principal species: *M. pseudotropicalis.*
Group IX (*Monilia pseudolondinensis*).—Gas produced in *dextrin in addition to other sugars.*
Principal species: *M. pseudolondinensis*, *M. pseudolondinoides*, *M. africana.*
Group X (*Monilia pseudotropicalis*). — Gas produced in *lactose in addition to other sugars.*
Principal species: *M. pseudotropicalis.*
Group XI (*Monilia zeylanica*).—Gas is *not* produced in any sugar.
Principal species: *M. zeylanica* (yellow), *M. zeylanoides* (white, no darkening of lead agar), *M. macroglossiæ* (lead agar darkened).

When the isolated monilia has been placed in one of the above groups, the determination of species is not difficult, having recourse to the complete table of monilias, published by one of us in several previous papers, and which may be found also in Castellani and Chalmers' "Manual of Tropical Medicine," pages 1082 to 1083. We give in next column an abridged table.

Broncho-anaeromycosis.—We introduced this term to indicate a chronic bronchitic condition, often hæmorrhagic, associated with the presence of minute fungi in the sputum, which show intermediate characters between organisms of the genera *Nocardia* (Toni and Trevisan) and *Cohnistreptothrix* Pinoy of the family Nocardiaceæ (Castellani and Chalmers), and the genera *Mycobacterium* (Lehmann and Neumann) and *Corynebacterium* (Lehmann and Neumann) of the family Mycobacteriaceæ Miche. We created a new genus for it: *Anaeromyces* Castellani, Douglas and Thompson.

The organisms of the group Anaeromyces are very closely related to the genus *Corynebacterium* (Lehmann and Neumann) (diphtheria and diphtheroid bacilli), and the genus *Nocardia* Toni and Trevisan (*Actinomyces* Harz, *Discomyces* Rivolta, *Streptothrix* Rossi-Doria, *Oöspora* Sauvegeau and Radais, *Cohnistreptothrix* Pinoy *pro parte*); but in contrast to the former branching is much more marked, and they are strictly anaerobic, and in contrast to the latter the mycelium is very much less developed, the growth is moist and not dry and crinkled, and they never give rise to actinomytic granules in the lesions. They are Gram-positive, non-motile, and not acid-fast. These germs, or similar ones, were found in cases of bronchitis in 1904, by Chalmers and one of us, and were referred to at the time as "bronchial anaerobic diphtheroid bacilli," but the observation attracted very little notice. They are also somewhat similar to *Bacillus vitulorum* Flügge.

Clinically, the condition can hardly be distinguished from either pulmonary tuberculosis or hæmorrhagic broncho-moniliasis.

Anaeromyces bronchitica Castellani, Douglas and Thompson, 1922.—*Morphological and staining characteristics.*—The organism is bacillus-like, 3 to 5 microns by 0·3 micron, and resembles in shape a diphtheroid bacillus, but branching is much more marked. It is Gram-positive and not acid-fast, and by staining by Neisser's method no metachromatic granules are seen.

Motility.—The organism is non-motile.

Relation to Oxygen.—The organism is an obligate anaerobe.

Cultural Characters.—Provided a strictly anaerobic technique is used the germ grows well in any of the usual laboratory media. The growth on glucose and other sugar media is not very characteristic; gelatine and serum are not liquefied.

Biochemical Reactions.—There is no formation of acidity or gas in any carbohydrate with which we have experimented, viz., glucose, levulose, maltose, galactose, saccharose, lactose and inulin. Milk is not clotted.

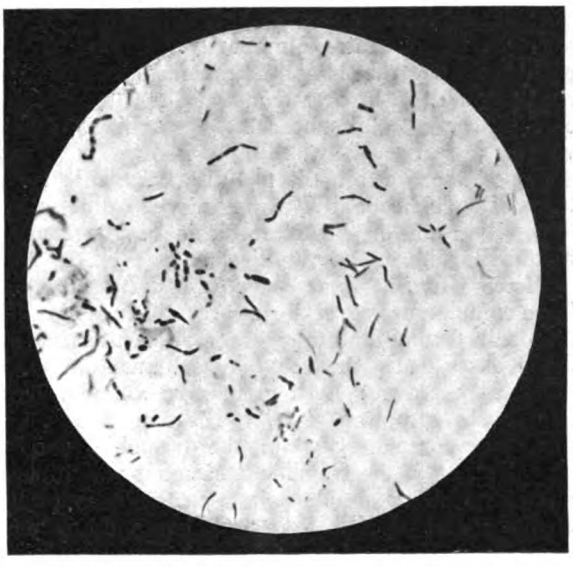
Pathogenicity.—This organism does not seem to be pathogenic to guinea-pigs or rabbits, even when

TABLE I.—SHOWING CHARACTERS OF VARIOUS MONILIAS.

	Glucose	Levulose	Maltose	Galactose	Saccharose	Lactose	Mannite	Dulcite	Dextrin	Raffinose	Arabinose	Adonite	Inulin	Sorbite	Starch	Glycerine	Inosite	Salicine	Amygdalin	Inosdulcite	Erythryte	Gelatine	Serum	Litmus Milk	Colour of growth on glucose agar
Monilia zeylanica Castellani	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Yellowish
Monilia zeylanoides Castellani	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	White
Monilia balcanica Castellani	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	White
Monilia parabalcanica Castellani	G	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	White
Monilia krusei Castellani	G	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	White
Monilia parakrusei Castellani	G	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Yellowish or brownish
Monilia (*Cryptococcus*) *castellanii* Re	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia pinoyi Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia nabarroi Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia metalondinensis Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia pseudolondinensis Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia alba Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia pseudolondinoides Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia africana Maché, 1921	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia albicans, Robin	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia tropicalis Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia metatropicalis Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia rhoi Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia guillermondi Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia macedoniensis Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia macedoniensoides Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	Dark brown
Monilia chalmersi Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia parachalmersi Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White
Monilia pseudotropicalis Castellani	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	White



Anaeromyces bronchitica from a glucose-agar culture. × 1,000.



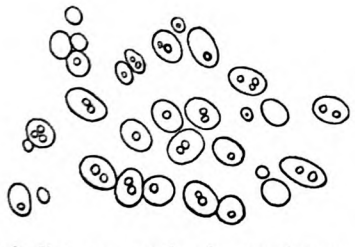
Anaeromyces bronchitica from a 10 per cent. glycerine peptone water. × 1,000.



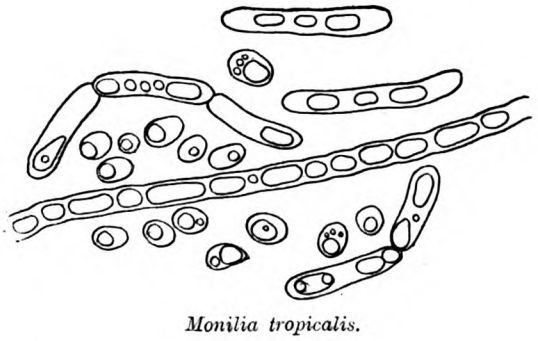
Anaeromyces bronchitica: glucose-agar culture.



Monilia tropicalis: glucose-agar culture.



Monilia tropicalis: preparation from a glucose agar culture.



Monilia tropicalis.

injected in large doses, either subcutaneously, intravenously, or intrapulmonarily. Although non-pathogenic to the lower animals we came to the conclusion that the organism was the causative agent of certain cases of hæmorrhagic bronchitis, because a vaccine prepared with the fungus induced in them the disappearance of all the symptoms. This type of hæmorrhagic bronchitis can hardly be differentiated clinically from either tuberculosis of the lungs, or hæmorrhagic broncho-moniliasis.

Mixed Monilia and Anaeromyces Infection.—We have come across several cases of what we consider a true mixed monilia + anaeromyces infection. In these cases both the monilia and anaeromyces are constantly grown: both germs are abundant while the severe symptoms last, to become scanty or to disappear completely when the bronchial condition improves, or is cured. The treatment which usually answers well in simple primary moniliasis (iodides, creosote and monilia vaccines) has only a partial success in these cases. The treatment which is generally very successful in simple anaeromycosis (anaeromyces vaccine) does not induce a cure, but only an improvement. These cases are frequently completely cured by combining the two treatments.

We quote the following illustrative case: Mrs. N., aged 41. Married. Nothing of importance in the family history. Had some of the usual children's diseases: whooping-cough and measles. Went to Southern India in 1903, and after a few months was married there. Enjoyed good health until 1917, when she began complaining of a slight cough with scanty mucous expectoration, the cough got gradually worse and she occasionally brought up blood. She consulted a local practitioner, who put her on arsenic and gave her some balsamics. During the next two years her condition became gradually worse, and she was sent home in 1920 with the diagnosis of probable pulmonary tuberculosis, though no tubercle bacilli had ever been found. The lady came to consult one of us. She was extremely emaciated and looked very anæmic. She was complaining of a severe cough and a feeling of great lassitude. Very slight serotine fever. The sputum was muco-purulent with usually a certain amount of blood. The physical examination of the chest revealed coarse, dry and moist râles, but no patches of dullness and no crepitations.

Microscopical and Bacteriological Examinations.—The sputum was examined thirty times for T.B., using also the antiformin method, with negative results. Cuti-reaction and ophthalmo-reactions negative. The direct microscopical examination of the sputum never revealed presence of mycelial or conidial bodies except on one occasion. The cultural investigation carried out, by using aerobic and anaerobic methods, showed on every occasion the presence of both a *Monilia* and a strain of *Anaeromyces*. The *Monilia* produced gas in glucose, levulose, maltose and galactose. It did not liquefy either gelatine or serum, and did not clot milk; it belongs therefore to the type *Monilia metalondinensis*. Inoculated intrapulmonarily into a rabbit, it produced a generalized nodular condition of both the inoculated and non-inoculated lung, the invasion of the non-inoculated lung taking place, apparently, via the bronchi. The histological examination of sections of the smaller nodules shows in the centre, masses of small cells, both polymorphs and leucocytes. Further out the cells are fewer in number. This corresponds to the area of degenerating expanded bronchiole. Still further out there is a ring of endothelial cells; many of them are phagocytes, containing smaller white cells, and there are a few large multinucleated giant cells, and also in this ring there is a large number of eosinophile cells. The same nodular cells in the centre are markedly degenerated and are becoming caseous. The sections stained with Gram show only a very few mycelial segments and very scanty spores so stained. Between the nodules there is a certain degree of congestion but no true pneumonia; there is a considerable increase of endothelial cells. In the small arteries one notices that the intima is greatly thickened.

Strain of Anaeromyces isolated.—This strain does not produce any lesion in rabbits or guinea-pigs when inoculated either intrapulmonarily or intravenously, but this is the case with all other strains of anaeromyces with which we have experimented.

Course and Treatment.—During the first two months the treatment was carried out only for the moniliasis: potassium iodide, creosote, glycerophosphates and monilia vaccines. The result was satisfactory, the general condition improved enormously the expectoration greatly decreased in amount, but did not disappear completely, and now and then a trace of blood was present. Injections of an autogenous anaeromyces vaccine were then given, one every other day, and the cough and expectoration disappeared completely within six weeks. The patient was feeling and looking very well and all treatment was discontinued. For two months the lady felt well, then again she began coughing, with hæmorrhagic sputum, and again she began losing weight. We started the anaeromyces vaccine without giving potassium iodide and creosote. The blood disappeared from the sputum almost completely, but the expectoration remained fairly abundant, muco-purulent occasionally slightly tinged with blood, and the general condition did not greatly improve. We then gave the iodide and creosote in addition to the anaeromyces vaccine and the condition cleared up completely, and the lady has since been in apparently perfect health.

Conclusions.

From observations and researches carried out during the last four years, we have come to the conclusion that a true mixed monilia + anaeromyces infection exists, in which each of the two organisms plays an ætiological rôle. We base our opinion, not on the fact that in these cases both organisms are found in the sputum, as one of them might play only a saphrophytic rôle, but principally on the fact that in such cases the specific treatment for simple broncho-moniliasis (iodides, creosote) and the specific treatment for anaeromyces (anaeromyces vaccine

given alone are not sufficient to induce a cure, while this is obtained by combining the two treatments.

In a future paper we propose dealing with other mixed mycotic infections.

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TREATMENT OF CHOLERA AND ITS COMPLICATIONS.[1]

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The treatment of cholera depends chiefly upon the stage of affection, so it is better to recapitulate the *different stages* briefly.

According to the classical textbooks cholera has three stages, but I prefer to describe four stages, as the patients do not enter the collapse stage after the premonitory diarrhœa (though some of them really do); the intervening or the transitional stage is known as "true cholera."

1.—*Preliminary or Premonitory Diarrhœa.*—It is characterized by the frequent passage of bile-coloured diarrhœic stools, sometimes with vomiting; specific gravity of blood is not affected.

2.—*True Cholera.*—During this stage there is frequent passage of rice-water stool, vomiting, pains and cramps in the muscles of the extremities and abdomen; urine is scanty and highly coloured, and specific gravity of blood gradually rises with depletion of fluids from the system through evacuation and vomiting. With Indians the normal specific gravity of blood varies between 1052 and 1054; in Europeans it is between 1054 and 1056.

3.—*Collapse.*—In this stage there is very low blood-pressure, about 70 mm. Hg, very feeble or collapsing pulse, markedly high specific gravity of blood, subnormal temperature, suppression of urine, &c.

4.—*Reaction.*—This stage is reached when the system is trying to come back to normal, by improvement in the general condition shown by vasomotor equilibrium, passage of urine, &c.

[1] Read at the November meeting of the Orissa Medical Association, Cuttack, India.

Now concerning the treatment, the most important thing to be borne in mind is *the value of time*, the sooner it is begun, the better for the patient, and the more so for society as the sporadic cases often lead to epidemics.

No present treatment is specific in the true sense, it is only symptomatic based on general physiological principles. The indications of treatment are as follows:—

(1) To replace the lost fluid in the system.

(2) To relieve the painful cramps.

(3) To lessen the activities of the absorbed toxins.

(4) To lessen the number and multiplication of cholera vibrios in the intestine.

For the first two, saline injections are required; the third factor is aimed at by measures that are required to dilute the concentrations of toxins in the system and help the free urination, either by administration of sufficient fluids, alkalies, or improvement in circulation. We have got very little means to prevent multiplication of the cholera vibrios, which is approached by administration of oxidizing agents (e.g., potassium permanganate), or the mild antiseptic and hepatic stimulant (e.g., hydrargyri subchlor.) and at the same time without stopping evacuation, which is really Nature's attempt to eliminate microbes and their toxins.

The composition of salines (Rogers) which I will often have to refer to is given below:—

1. *Hypertonic saline.*

Sodium chloride	120 gr.
Calcium chloride	4 gr.
Aqua distilled	Oj

2. *Isotonic saline.*

Sodium chloride	90 gr.
Aqua distilled	Oj

3. *Hypotonic saline.*

Sodium chloride	60 gr.
Sodium bicarb.	160 gr.
Aqua distilled	Oj

For the preparation of the hypotonic saline, first mix sodium chloride with water and boil it; when it is boiling put out the stove and mix at once fresh and clean sodium bicarb.—never boil after the addition of sodium bicarb. Often in treatment hypertonic has to be poured into the flask from which hypotonic is flowing; in that case let the hypotonic flow out from the flask leaving the smallest quantity possible with safety, otherwise $CaCl_3$ of the hypertonic mixes with sodium bicarb. of the hypotonic to form inert and insoluble calcium carbonate (chalk).

For the *specific gravity of blood* mixtures of glycerine and water in different proportions (specific gravity ranging from 1050 to 1070) are used. The saturated solution of magnesium sulph. can be conveniently used for the same purpose (Dr. D. N. Bannerjee); its specific gravity is 1220; of this take 5 c.c., mix with it 15 c.c. of clean sterile water, and the resultant solution has the specific gravity 1060 always. The magnesium sulphate solution can be made at any

place and at any time; moreover, the treatment can be guided more or less in the right path by noting the drop of blood ejected from the pipette at the mid-level of the solution in a one-drachm phial; if the drop is stationary, the specific gravity of blood is 1060; if it floats up, the specific gravity is less; if it sinks down, the specific gravity is more; by careful observation a rough estimate of specific gravity can be made from the rate of rapidity of the blood, either in floating up or in sinking down. This method is of much service for those who cannot always keep a fresh supply of glycerine mixture. I have often used it and it has never failed me.

Now let me divide *the treatment* according to the stage of infection.

In the Premonitory Stage the disease can often be cut short by administration of simple astringent mixtures or powder, if infection is not virulent and the bile is present in the stool.

℞	Pulv. cretæ aromat.	20 gr.
	Bismuth carb.	10 gr.
	Mucilage	q.s.
	Spt. ammon. aromat.	10 min.
	Spt. chloroform	10 min.
	Tinct. caro. co.	20 min.
	Aqua menth. pip.	ad 1 oz.
	mft. mist. Every 4 hours.	

Or,

℞	Tinct. opii or chlorodyne	15 min.
	Acid. sulph. dil.	15 min.
	Aqua menth. pip.	ad 1 oz.
	mft. mist. Every 4 hours.	

There is some objection to the second mixture as there is no knowing whether the progress of the disease will stop here; if it does, well and good; but if it does not, is it advisable to push the opium preparations, which irritate the kidneys by their excretion, only to pave the way for the so much dreaded uræmia, which is in fact a fatal complication of cholera? Another factor might creep up unconsciously. Suppose a patient is given the second mixture every four hours, and slowly passes to the collapse stage at which there is no absorption from the stomach, but the medicine is still given regularly, as often happens; now, if the patient ever reaches the reaction stage, there will be sudden absorption of a huge quantity of opium preparation only to produce the toxic effects of it.

The patient is never to be purged when there is any apprehension, especially during the outbreak of an epidemic, with salines which denude the intestinal mucous membrane only to make it an easy prey to the disease.

In the Stage of Cholera and Collapse.—Blood-pressure and specific gravity of blood are to be taken carefully and regularly for the guidance of treatment; the total quantity of urine passed should also be noted.

(*a*) If blood-pressure is 70 mm. Hg or below, give intravenous saline, not less than two pints, to bring up the pressure for efficient circulation.

(*b*) If specific gravity is over 1060, inject Oj hypertonic for each degree of rise above 1060, but not more than four or five pints at a time.

(*c*) If blood-pressure is low and specific gravity is 1060, at least three pints of hypertonic are needed.

(*d*) When specific gravity is 1054 or thereabout, and the injections are indicated, isotonic saline is to be given instead of the hypertonic to correspond with the tonicity of blood.

Intravenous saline injections are also given for the relief of cramps and restlessness, which are due to the small amount of fluid in the system. To combat toxæmia and suppression of urine plenty of sodium bicarb. is to be given, preferably in the form of hypotonic saline by intravenous method. To quote Sir Leonard Rogers, "the alkalinity of blood is nearly always much reduced in severe cases of cholera, and that the early and repeated administration of sodium bicarbonate intravenously has lowered the mortality from uræmia to the fourth of its former rate; it is now clear that the rule I have adopted of giving alkalies intravenously in all cases of cholera with each saline injection after the first, as well as with the first injection in late admission with deficient urinary secretion, is a sound one, which should never be neglected."

Therefore it is advisable that the first pint should always be hypotonic saline (sodium bicarb.) whenever it is required to increase the alkalinity of blood, as rigor may set in at any time and prevent further intravenous administrations.

Repetition of intravenous injection is called for when (1) blood-pressure is very low, the patient is pulseless and restless; (2) there is suppression of urine; (3) specific gravity of blood is high.

It is better to add adrenalin or pituitrin, 1 c.c. to every injection to stimulate the broken-down vasomotor system. When the system loses fluid very quickly by copious evacuation or vomiting after each intravenous injection, *subcutaneous injections* are needed: the latter method of administration is also needed if the person is very obese or the vein is very small.

INTRAVENOUS INJECTION.

Advantage.	*Disadvantage.*
Quick, sure absorption of known quantity of saline; painless, no chance of abscess formations, less asepsis required in comparison with the subcutaneous method.	Embolism.

"The cyanotic, algid, pulseless, breathless creature with shrunken, wrinkled features, sunken lustreless eyes, and the whole aspect of a moribund, will, as if from a deep sleep, arouse himself and tell the delighted doctor he feels vastly better."

As regards the *rate of injection*, the first pint should take about 7-10 minutes; later 10-12 minutes per pint. If there is any cardiac or respiratory trouble the patient is to be carefully watched and the rate of injection should be very slow. Very rapid injections often cause œdema of lungs or acute heart failure.

The *temperature of salines* to be administered intravenously should be regulated carefully for fear of severe reaction. If the rectal temperature is normal, or below normal, the salines should be at 100° F.; if the rectal temperature is 102° F. the salines should be at 90° F. or thereabout.

In young children the saline cannot often be administered intravenously owing to the fine calibre of the veins; subcutaneous method is substituted, accompanied by the continuous administration of isotonic rectal saline (with sodium bicarb. gr. 160 and 5 per cent. of glucose per each pint). The isotonic rectal saline is stored in a thermo flask at 37° C., and from this the saline flows slowly drop by drop high up into the rectum through a rubber catheter; the flow is so regulated that one drop falls per second. By these methods the required quantity of fluid is sufficiently given.

SUBCUTANEOUS INJECTION.

Advantages.	*Disadvantages.*
No operative difficulty, no chance of embolism.	Chance of abscess formation; slow absorption and painful, at one site not more than Oj can be given.

Intraperitoneal methods have been used with success by some authors.

Rectal injections of 10 oz. of isotonic saline with sodium bicarb. 160 gr. to Oj should be given as a routine measure every two hours; 5 per cent. of glucose may be added to it conveniently. This rectal saline lessens the need of intravenous saline injections.

As a routine measure, too, a hypodermic injection of atropine $\frac{1}{100}$ gr. and digitalin $\frac{1}{100}$ gr. given twice daily gives good results, as very little drug is absorbed from the stomach in such conditions.

Potassium permanganate pills (2 gr. with kaolin) are given every fifteen minutes till 20 gr. are given and then two pills every half hour till colour of steel changes to green; but this treatment increases nausea and the patient feels worse. Hydrargyri subchlor. is generally given in fractional doses $\frac{1}{6}$ or $\frac{1}{4}$ gr. every half hour till 2 to 3 gr. are administered.

For vomiting, small pieces of ice are given to suck; tincture iodine in minim doses every fifteen minutes for two hours answers well in some cases. Fifteen minims of adrenalin may also be administered.

For tympanitis, fractional does of either calomel, menthol, thymol or camphor, or a combination of them, is given every half hour; paralytic distension responds to pituitrin only.

Stage of reaction, especially after an intravenous administration. Temperature should be brought down; it should be taken every fifteen minutes for two hours, and necessary steps to be taken on the first apprehension, i.e., only one bed sheet to cover the body, ice caps, cold sponging, &c. Many lives are lost due to inefficient management in this stage for hyperpyrexia.

Diarrhœa is never to be checked unless severe, as it eliminates toxin. When urine is free, but the stool is frequent and less formed:—

℞ Bismuth subgallate ... ... 15 gr.
Tanalbin ... . 10 gr.
Pulv. cretæ aromat. ... . 1 dr.
mft. pulv. Every four or six hours.

Kaolin Treatment.—One school favours it much, though in my experience it proved to be a failure. About a tablespoonful is required mixed with half a tumblerful of water into a uniform mucilaginous suspension, which is administered per mouth every four hours and *per rectum*, too, at intervals, till the patient passes kaolin in each stool. For acidosis sodium bicarb. is administered by mouth; when there is much loss of fluid, the isotonic saline is administered intravenously. The aim of treatment is to protect the denuded intestinal mucous membrane, and at the same time to check the multiplication of the vibrios. The Vienna school gave satisfactory reports of this product, but it did not prove useful in the hands of experts in India.

Complications.—(1) Tympanitis.—It has been dealt with previously; hot turpentine stupes and long flatus tube may be tried. Sometimes, in spite of all possible efforts, severe tympanitis persists for five or six days, and with the improvement of the condition it slowly disappears.

(2) *Uræmia.*—The administration of sufficient fluid and sodium bicarb. in the system diminishes its possibilities. When there is sufficient fluid in the system and specific gravity is below or about 1056, one pint of hypotonic saline or isotonic saline with 160 gr. of sodium bicarb. per pint often relieves the condition by causing free urination. Alkaline should be given per mouth too. I saw one case having no other sign but exhausting uræmic hiccough; sufficient alkali was given, the specific gravity of blood was 1054, and the blood-pressure fairly normal, but he was constipated and passed little urine; he was given an ounce and a half of castor oil every day for three or four days; the hiccough disappeared later on and the patient was quite well within a week.

Sometimes tinct. apocyanaci and caffeine sodium of benzoas give marvellous results.

(3) Œdema of lungs may be present, due to the rapid administration of salines or in failing hearts. Atropine $\frac{1}{50}$ gr. should be given intravenously immediately, and the administration of intravenous saline should be stopped. If fluid is at all necessary subcutaneous injection is to be given.

(4) Pneumonia, hypostatic or septic should be treated on general principles. If this condition sets in early the case is hopeless; here subcutaneous saline can be given very cautiously in urgent needs.

(5) Corneal ulcer is treated on general principles. For the prevention of it during the collapse stage the eyes should be washed with boric acid lotions at intervals and a mild antiseptic ointment such as ung. hydrargyri oxidi flava ($\frac{1}{2}$ per cent.) applied.

(6) Gravid uterus cannot stand the affection; it either ends in abortion, miscarriage or death of the fœtus.

(7) Septic infections might occur at the site of injections due to bad management.

(8) Sudden heart failure during the convalescent stage has been seen by me when the case was about to be discharged from the ward as there was nothing clinically abnormal.

(9) Relapse, though rare, should not be entirely forgotten; this might occur through injudicious diet.

(10) Local vasomotor spasms might occur during administration; atropine, $\frac{1}{50}$ gr., associated with gentle

massage of the veins of the upper arch from below upwards relieves after a few minutes. Sometimes this is often mistaken for clot, either in the canula or vein; this error can be easily avoided if a glass connection is interposed just before the canula; in any doubt clamp the rubber tubing on the proximal side of the glass connection, when the blood will flow into the glass piece, showing thereby the absence of clot (*vide* author's note in *Indian Medical Gazette*, September 23). In this condition the veins in the upper arm stand out prominently like whip-cord.

Diet.—In acute stage nothing but plenty of cool green coconut-water or thin barley-water with lemon-juice is to be given in sips. When the acute stage is over, add whey to the diet list. Later on, during convalescence, when the patient is passing formed or semiliquid bile-coloured stools, citrated milk or Horlick's may be given; slowly and very cautiously normal diet may be taken.

Hygienic measures are to be adopted in the disinfection and disposal of the excreta and clothes. They are to be well soaked in 5 per cent. carbolic acid lotion for three to four hours, and then boiled before being sent away for washing. The convalescents are to be examined before they leave hospital for the persistence of cholera vibrios in their excretions, because some of them eventually are cholera carriers. These cholera carriers are really a menace to society, especially if they have to handle food-stuffs. They respond to the vaccine treatment.

Prophylaxis.—During the outbreak of an epidemic Haffkine's prophylactic treatment with vaccine is useful.

All attention should be directed to the water supply for efficient chlorinization with bleaching powder. Segregation of the patients should be carried out immediately.

Croonian Lectures on Researches on Leprosy and their bearing on the Treatment of Tuberculosis. Lecture IV, "The use of Chaulmoogrates and Morrhuates in the Treatment of Tuberculosis" (Sir Leonard Rogers, *The Lancet*, June 26, 1924).—From this interesting paper it is seen that while chaulmoogra oil derivatives have proved of great value in the treatment of leprosy, the morrhuates in small subcutaneous doses have proved both safer and more effective in tuberculous disease. This has been confirmed by several experts; although it has sometimes been found that sodium morrhuates have given negative results in cases of advanced disease and cases with poor resistance, but the number of these is inferior to the number of cases which have greatly benefited by the treatment. The complete disappearance of tubercle bacilli from the sputum has been obtained in a certain proportion of advanced cases, some of whom had resisted sanatorium treatment. The results of sodium morrhuates in surgical tuberculosis leave much to be desired, but are not without promise. These investigations have proved to be a valuable contribution to general medical science.

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THE JOURNAL OF

Tropical Medicine and Hygiene

JULY 15, 1925.

THE VINCENT D'ANTONI HOSPITAL IN HONDURAS.

WE have on several occasions called attention to the rapidly increasing importance which is given at the present time in the United States to the study of tropical medicine and investigation into tropical problems.

A very important feature of the moment is the interest taken in the subject by private concerns and corporations. Some of these concerns have complete medical services of their own. The United States Fruit Company, for example, has a tropical medical service admirably organized by Dr. E. Deeks, with branches in several Central American countries. At the head of each branch or division there is a principal medical officer with an adequate medical and nursing staff.

A magnificent hospital has been recently erected in Ceiba, Spanish Honduras, by the well-known American firm of Vaccaro Brothers of New Orleans, U.S.A., as a memorial to Vincent D'Antoni, Local Manager of the Company, who was a man beloved by all classes of the native population and during his short lifetime greatly contributed to the welfare of the native population and to the progress of the whole country.

The Hospital is of the pavilion type and constructed of hollow tile and stucco, with a red Spanish tile roof. It is ideally located at the foot of a high ridge of mountains where the climate is pleasant throughout the whole year. It is well equipped with receiving wards, accident room, laboratories, X-ray rooms, operating rooms, private rooms, offices and library; all windows and verandas are completely screened. The furniture throughout the Hospital is of metal finished in mahogany colour.

One of the chief activities of the institution is the out-patient department. The Honduras Government has arranged to conduct an intensive campaign against ankylostomiasis and malaria and other tropical diseases of Honduras, under the auspices of the Rockefeller Foundation working in conjunction with the National Health Department. The Vincent D'Antoni Hospital has been selected as the headquarters for this work. The treatment for these diseases in the out-patient department will be free of charge to all natives.

A somewhat unusual feature of the staff organization in a tropical hospital is the provision for an honorary staff upon which any distinguished physician or surgeon may be placed on the recommendation of the superintendent, who was until recently Dr. William H. Walsh, an expert on hospital organization. The first members appointed were the professors of the National Medical School of Honduras, the representatives of the Rockefeller Foundation, the director of the National Health Department, and certain foreign physicians and surgeons resident in the United States and Europe, who have consented to hold clinics at the new hospital from time to time.

The hospital is provided with a complete and up-to-date dental department which is in charge of a native visiting surgeon, a graduate of an American dental college. A resident dentist will be appointed at an early date.

The cost of building and the entire equipment of the hospital has been defrayed by Vaccaro Brothers; the firm also gives a very large annual grant for the upkeep of the institution.

The Vincent D'Antoni Hospital is an institution which not only gives the best modern treatment and care to the sick, but is fast becoming a centre of research and medical education in Honduras.

Annotations.

A Clinical and Experimental Investigation of Arsphenamin Poisoning (Soma Weiss, *Journal of the American Medical Association*, Feb. 21, 1925).—Cats were used in experiments designed to study the gross and microscopic tissue changes produced in the liver, spleen and kidneys by arsphenamin. by arsphenamin together with mercuric salicylate, and by arsphenamin administered after chloroform. The doses of arsphenamin, corresponding to massive therapeutic doses, produce small areas of necrosis, fatty infiltration, congestion with round-cell infiltration, and occasionally cloudy swelling in the liver cells, with the evidence of fatty degeneration in the tubules of the kidneys in some cases. The poisons produced no changes in the spleen. This tissue injury was not increased or modified when arsphenamin was combined with mercuric salicylate in amounts corresponding to therapeutic doses in man. Arsphenamin does not appear to increase the injury produced by chloroform.

Immunity in Rocky Mountain Spotted Fever (Charles L. Connor, *The Journal of Immunology*, July, 1924).—The investigations carried out show that the behaviour of the virus in the tick and in laboratory animals is contrasted. The fact that there are so few organisms in the blood may be the reason why the virus in this situation is not amenable to attenuation. It has been shown that in tick tissues and in the tissues of guinea-pigs the virus may be attenuated by drying in the cold, and that after keeping for from five to thirty days at a below zero temperature, the tissue is no longer virulent, but will produce immunity. Several methods of using combinations of virus and immune serum have been tried. The most effective seems to be where virus is given in rather large dose and allowed to grow for twenty-four hours, when a dose of serum is given to stop the infection. Another method which is successful under limited conditions is the giving of large doses of mixture of virus and serum. It is shown that an immunity may be achieved which equals that following an attack of the disease. The same mixtures heated to 60° for twenty minutes have been ineffective. The virus serum mixtures are applicable for the present to guinea-pigs only. It is questionable whether the same amount of immune serum which will protect a guinea-pig against a certain amount of virus will protect a larger animal, and whether the same amount of virus that will produce immunity in the guinea-pig will do the same for a larger animal. A virus that is much more concentrated is desirable, and one that may be calculated as to its minimum infectious dose prior to administration. The fact that immunity depends only on the amount of virus given is brought out, the immune body having nothing to do with the production of immunity in another animal.

Study of the two hundred and two Cases of Hay Fever (G. Piness, *Journal of the American Medical Association*, Feb. 21, 1925).—The author discusses in detail the technique of the various procedures employed in the diagnosis and treatment of 202 cases of seasonal pollen hay fever, 1923. The results of these observations are, that a thorough botanic survey of all the air-borne plants is necessary before one can intelligently diagnose and treat hay fever. The method of collecting pollens and their preservation, as described in this article, is the most satisfactory one at hand. A correct diagnosis is essential for good results, and is simplified by a thorough study of the history in each individual case, in connection with a local pollen survey and plating, if necessary. The scratch method (cutaneous method) gives as good reactions as does the intracutaneous method, with less liability to constitutional reaction. The treatment on the assumption of group reaction is not as satisfactory as treatment based on tests. Preseasonal desensitization is a method of choice, and gives the best results when properly administered. Multiple sensitization is common in the vicinity studied. At least 87 per cent. of series were of that type. Bermuda grass (*Cyndon dactylon*) is the most frequent offender in the South-west. Reactions incident to treatment occurred most frequently in the patients who obtained the greatest amount of relief. The results obtained by preseasonal immunization compare favourably with those of other workers, and are quite uniform in that the average obtained by all workers is about 23 per cent. complete relief. From the results obtained by all the workers, much hope and promise of relief may be offered to the hay fever sufferer.

The Identification of the Organism of Rocky Mountain Spotted Fever in the Blood (Ch. L. Connor, *The Journal of Infectious Diseases*, vol. 35, No. 6, December, 1924).—The organism of Rocky Mountain spotted fever may be found in the blood and cell-free serum of infected guinea-pigs by dilution and prolonged centrifugation. Staining for more than four hours in Giemsa's stain, and differentiation in 95% alcohol, seem necessary to bring it out properly. The organism may be found by recovering infected blood from the peritoneum of a normal guinea-pig two days after the intraperitoneal inoculation. The fact that it has been found in the blood and serum does not completely dispense with speculation as to the real form of the organism in this situation. The small numbers found may be present from broken-down cells, and be quite accidental and transient. The unusual virulence of the blood (0·001 c.c. often being infectious) seems somewhat incompatible with the exceedingly small number of organisms found.

The Rôle of the Domestic Cow in the Epidemiology of Undulant Fever (J. T. Duncan, *Trans. of the Royal Soc. of Med.*, February, 1925).—From these studies it is clear that the strain " B " isolated from a case of Rhodesian undulant fever described is a *Brucella* of serological Group I (Feusier and Meyer). The cultural tests, as far as they showed any differences between *B. abortus* and *B. melitensis*, showed strain " B " to resemble *B. abortus*. The weight of evidence tends to point to *B. abortus* as the cause of Rhodesian undulant fever, and to the cow as the source of infection, but experimental proof that *B. abortus* from the Rhodesian cattle disease is pathogenic for man has not yet been supplied, nor is there available any trustworthy test to distinguish *B. abortus* from *B. melitensis* of Group I (Feusier and Meyer).

The Activation of Yeast-Absorbed Complement with Heated Sera (Roscoe R. Hyde, *The American Journal of Hygiene*, March, 1922).—Yeast-absorbed guinea-pig complement can be activated with minimal amounts of heated human or guinea-pig serum (56° 30′) in which a sufficient amount of sensitizing sera (approximately 5 units) is employed, provided the corpuscles are added after the other reagents have been added to the tubes. The zone of hæmolytic activity begins in the tubes containing approximately 0·04 c.c. of the heated sera and spreads to the tubes containing 0·1 c.c. If the number of sensitizing units is increased, covering a range from 5 to 100, the prezone practically disappears and the hæmolysis may extend to the tubes containing 0·005 of the heated serum. In those sets containing the same reagents, but in which the addition of the corpuscles and heated serum is interchanged, no hæmolysis occurs. If the sensitizing serum is reduced to less than 5 units the hæmolytic zone may shift to the tubes containing heated serum ranging from 1 c.c. to 0·1 c.c. In this case the hæmolytic action begins in the tubes containing approximately 0·5 c.c. and spreads to the other tubes in this zone. In this case the quantity of sensitizer can be adjusted so that hæmolysis results within this zone in those sets to which the corpuscles were incubated with the other reagents, before the addition of the heated sera, but not in the control set, in which the order of addition of the corpuscles and heated serum is reversed.

The Reaction Product which inhibits Reproduction of the Trypanosomes in Infections with Trypanosoma lewisi, with special reference to its Changes in Titre throughout the Course of the Infection (F. A. Coventry, *The American Journal of Hygiene*, March, 1925).—The presence of the reaction product which inhibits reproduction of the trypanosomes could not be demonstrated in the blood of infected rats on the fifth day of infection. The reaction product must be present before the fifth day, because the rate of reproduction is declining by that time. There is a sudden, very great, increase in the titre of the reaction product between the fifth and sixth days of the infection. There is

a gradual action in the titre of the reaction product between the seventh and, approximately, the thirty-fifth days of the infection. There appears to be a decrease in the titre of the reaction product from about the thirty-fifth day to the end of the infection.

The Treatment of General Paralysis by Inoculation with Malaria. A First Report (H. A. Bunker and G. H. Kirby, *The Journal of the American Medical Association*, Feb. 21, 1925).—Between June, 1923, and November, 1924, 53 unselected patients with general paralysis, in the male service of the Psychiatric Institute, have been inoculated with tertian malaria. Of the 53 patients inoculated, 11 have been treated too recently to allow an expression of opinion; 2 received a course of malaria on two separate occasions, and 1 failed to acquire the infection after repeated inoculation. Of the 39 patients remaining, 6 died during the actual treatment (5) or within a month of its completion (1), and 1 died eight months subsequent to treatment, after a slight remission of five weeks' duration. Three of the group of 6 died as a direct result of convulsions; in the case of the other 3 death may have been hastened, but was hardly directly caused, by the malaria. Of the 32 patients now alive at the end of from three to thirteen months from the conclusion of treatment, 14 are considered as either unimproved or more or less improved (only 1 of these 14 is definitely worse), and 18 are considered as much improved, and may be regarded as exhibiting fairly complete remissions with a residual mental defect, save in the case of perhaps 2 patients, either undemonstrable or of the slightest possible degree. Seventeen of these patients were discharged from the hospital from one to ten months ago, and 14 have returned to their occupations. These results, completely confirmatory of the data of similar type already published, lead to the belief that treatment of general paralysis with malaria is unquestionably a method of value. The authors believe that in the proportion of cases in which the disease appears to be brought to a standstill, as judged by clinical criteria, in addition to the proportion in which a striking degree of mental improvement comes about, is in itself not without possible significance.

Chronic Roentgen-ray Dermatoses as seen in the Professional Man (H. N. Cole, *Journal of the American Medical Association*, March 21, 1925).—The author believes that Roentgen-ray dermatoses in physicians and technicians are far more numerous than the literature would lead us to believe. Many cases, even severe ones, have probably never been reported. In six of the cases reported, a clinical diagnosis of malignant degeneration was made, and was confirmed microscopically in three. Two of these physicians have had a finger removed because of malignant change, and one has undergone several major operations, lost a thumb, had glands dissected out, and finally recovered through this and the use of electro-coagulation and radium. Roentgen-ray and radium, when used properly and with care, are not a danger to the patient or the operators. The author advises the adoption of the measures recommended by the Royal College of Physicians and the American Roentgen-ray Society for protecting the operators.

Mercurochrome-220 Soluble and Gentian Violet. Bactericidal Efficiency by Intravenous Route (I. C. Brill and H. B. Myers, *Journal of the American Medical Association*, March 21, 1925).—Clinical observations were made on three cases of bacteræmia and two cases of local gonococcal infections treated by intravenous injections of mercurochrome and gentian violet. These observations, which were carefully controlled by cultural checks, seem to indicate that in these five cases the intravascular injection of the dyes in no way interfered with the progress of the infection. Experiments on the effect of dilutions of mercurochrome and of gentian violet on the growth of staphylococcus, streptococcus and *B. coli in vitro* seem to indicate that there was no direct bactericidal action on those organisms from three hours' exposure to mercurochrome and gentian violet in concentrations of 1:10,000, representing the maximal advisable concentration of these dyes in the circulation.

Clinical Studies of the Kahn Reaction for Syphilis. III. The Test with Spinal Fluids (H. L. Keim and R. L. Kahn, *Journal of the American Medical Association*, March 21, 1925).—A comparative study was made of the Kahn precipitation test and two separate Wassermann tests, based on 1,000 spinal fluid examinations. The cases included: 222 of general paresis, 124 of tabes dorsalis, 387 of the diffuse type of neurosyphilis, 250 cases of syphilis with apparently no neurolgic involvement, and seventeen cases that showed central nervous system involvement of a non-syphilitic nature. The results indicate that the Kahn precipitation test compares favourably in specificity and sensitiveness with the Wassermann test.

On the Value of the Estimation of the Ionic Calcium of the Serum in the Diagnosis of, and as a Gauge of Progress in Sprue (H. H. Scott, *Annals Trop. Med. & Parasitology*, March 31, 1925).—The conclusions of this interesting paper are as follows: Sprue is a disease which is constantly associated with a fall in the amount of ionic calcium in the serum, whereas the total remains at or about normal. A rise and fall of the ionic calcium coincides with improvement and relapse. Absorption of calcium is little, if at all, interfered with, but calcium metabolism is upset. Consideration of this fact, and of some of the other symptoms of sprue, especially the cramps and tetany in severe or advanced cases, points to interference with the function of the parathyroid glands. Amelioration

of symptoms, followed by cure, is obtained by oral administration of suitable salts of calcium and a pure and active preparation of parathyroid in adequate doses. The period needed for cure by these means is much shorter than by previous methods, the main systems clearing up in some cases within a few days. The administration of the parathyroid must, however, be maintained to stabilize the amelioration, but no ill-effects have been found to occur if it be continued longer than is actually necessary to bring about this result. In the light of the above, it is interesting to note that most of the old empiric remedies contain lime as an important constituent.

Malaria Parasites in the Placental Blood (B. Blacklock and R. M. Gordon, *Annals Trop. Med. and Parasitology*, March 31, 1925).—Of twenty-six placentas of native women examined in Sierra Leone twelve, i.e. 46 per cent., were infected with *Plasmodium falciparum*. The infection in many of these placentas was massive. Examination of the peripheral blood of twenty-three of these cases revealed only four, i.e., 17 per cent., infected. In the placental blood, sporulating parasites were numerous, and also young and half-grown forms. Definite differences were observed in the number of merizoites produced by the parasites of different cases; these differences may influence the rapidity of onset and the course of the disease. Crescents were never found in the placental blood in any of the cases examined. No case of congenital malaria was encountered. Some evidence is produced which suggests that malaria infection of the mother predisposes to accidents during pregnancy or at birth.

A Disease of Fowls in Palestine characterized by Leucocyte Inclusions (S. Adler, *Annals Trop. Med. and Parasitology*, March 31, 1925).—A disease of fowls in Palestine characterized by various forms of chromatic inclusions in the leucocytes is described. The inclusions appear to be identical with the leucocytic inclusions described and figured by Macfie from Eket, Nigeria. The disease in Palestine is considered to be the chronic form of the disease described by Macfie. It can be transferred to healthy fowls by blood inoculation. The inclusions appear five to six days after the inoculation of infected blood; they are considered to be true parasites belonging to the Chlamydozoa. Transmission experiments with *Argas persicus* were unsuccessful, but the experiments are not conclusive.

The Eradication of Helminthiasis from the Egyptian Army (Major B. H. H. Spence, *Jour. Roy. Army Med. Corps*, May, 1925).—Fourteen per cent. of the soldiers treated in the Egyptian Army General Hospital in Cairo, in 1923, were admitted primarily for parasitic worm infestation. Twenty-nine per cent. of the men invalided in 1923 from the same hospital were invalided for the effects of chronic infestation with parasitic worms. Large numbers of "fit" men in the Egyptian Army suffer constantly from signs and symptoms of parasitic worm infestation without feeling ill enough to report sick. The Egyptian soldier is notoriously lacking in resistance to the adversities of military service in a bad climate. There is every reason to believe that this is the direct result of his constitution having been undermined by chronic infestation with parasitic worms. Ninety-one per cent. of a batch of 292 recruits for the Police School, Abassia, Egypt, were found to be infested with parasitic worms, some harbouring as many as four kinds. 73 per cent. had ankylostomiasis, 52 per cent. schistosomiasis, 7 per cent. ascariasis, and 3 per cent. other infestations. The 212 ankylostomiasis cases were treated with a single dose of five cubic centimetres of carbon tetrachloride. Three months later 79 per cent. were found to have been completely cured. For efficacy, ease of administration, mildness of after-effects, safety and cheapness, carbon tetrachloride is incomparably the best anthelmintic yet discovered for the treatment of ankylostomiasis amongst Egyptians. The 152 schistosomiasis cases were treated with 21 grains of antimony sodium tartrate divided into twelve doses and given on alternate days by intravenous injections. Of the 132 who were available for re-examination three months later, 95 per cent. were found to have been completely cured. By amplifying the dose on the lines indicated, it is probable that 100 per cent. of cures could be obtained in these comparatively lightly-infested healthy-looking recruits. Cure depends upon finding the limit of saturation the patient can tolerate and maintaining it till all the worms are dead. Antimony sodium tartrate merely kills the worms; it cannot be expected to repair hopelessly-damaged tissues. The derangement of the heart found in 16 per cent. of apparently fit recruits is probably the outcome of chronic toxæmia, due to long-standing infestation with parasitic worms. The necessity for subjecting all recruits for the Egyptian Army to a simple test for cardiac efficiency was clearly demonstrated.

Trichomonas vaginalis Donné (R. W. Hegner, *American Journal of Hygiene*, May 1925).—Vaginal mucous obtained from twenty women in the United Fruit Company Hospital at Tela, Honduras, and from twelve women in the United Fruit Company Hospital at Port Limon, Costa Rica, was positive for *Trichomonas vaginalis* in 50 per cent. of the cases at each hospital. Measurements of 100 specimens gave a range of from 7 microns to 21 microns in length, with a mean length of 16 microns and a range of from 6 microns to 18 microns in breadth with a mean breadth of 11 microns. Morphological studies of smears prepared by the Schaudinn-iron-hæmatoxylin method reveal (1) four anterior flagella, which arise from blepharoplastic granules usually in groups of two; (2) three, four or five blepharoplastic granules; (3) a large spindle-shaped nucleus containing many scattered chromatin granules and sometimes a

karyosome; (4) a small, undulating membrane which extends back about half the length of the body; (5) a flagellum which runs along the outer edge of the undulating membrane, but does not become free at its posterior end; (6) a chromatic basal rod accompanied by chromatic granules; (7) an axostyle extending from the blepharoplastic granules along one side of the nucleus and thence to the posterior end of the body, from which it often protrudes, and surrounded by several rows of chromatic granules; and (8) a fibril which arises from a blepharoplastic granule, extends along the side of the nucleus opposite the undulating membrane, is separated from the nucleus by a clear space, and probably represents a cystomal fibril within the lip of the cytosome.

Some Observations and Experiments on the Irritating Properties of the Larva of Parsa hilarata Staudinger (R. G. Mills, *American Journal of Hygiene*, May, 1925).—*Parsa hilarata* Staudinger has been found in North China (Peking and its environs) and has been shown to possess intense irritating properties. Injury is due to the mechanical introduction of a toxic substance by contact with any of the sharp-pointed spines widely distributed over its body. It is apparently not necessary for a portion of the spine to remain in the skin. The so-called "nettling hairs" are of very little importance. The toxic substance is contained within the spines, probably closely connected with the protoplasm, and has not been separated therefrom. It was destroyed or activated by almost every procedure employed, the chief exceptions being water, formalin 5 per cent. and sodium hydrate 1 per cent. Living larvæ are more irritating than the dead ones, regardless of the manner in which they are killed. Rigidity of the body is not a necessary factor in the production of lesions with killed larvæ. Spines, just severed from the body, retain their irritating properties, but preparations and extracts from various portions, and produced in many ways, failed to induce more than a slight mechanical injury in a few instances. The hypothetical toxic principle has not been definitely isolated, and very little is known as to its nature. Observations bearing on the habits and life-history of the species are described.

The Toxic Action of Oil Films upon Mosquito Larvæ with particular reference to Pine Oil Films (M. E. Barnes, *American Journal of Hygiene*, May, 1925).—Pine oil has a powerful soporific or paralysing effect upon mosquito larvæ and pupæ, and in effective doses results in their death either directly or, apparently, by drowning while under the effects of the drug. Anopheline and culicine larvæ, in many cases, may be resuscitated after prolonged submersion, even after being in contact with oil films. A method of resuscitating supposedly drowned larvæ is described. Crude oil is an efficient and economical vehicle for carrying pine oil to larvæ by means of film dosage. A mixture of crude oil and pine oil in the proportions of nine parts of the former to one of the latter produces a better film than either ingredient and one which is highly effective in destroying all stages of anopheline and culicine larvæ and pupæ. The ova of *Anopheles quadrimaculatus* Say are partially resistant to pine oil acting through films.

The Vitamin Content of the Banana (Eva Sopp, *Norsk Magazin f. Laegevidenskaben*, Kristiania, September, 1924).—Researches have proved that the banana is an excellent food for children. It contains 19-20 per cent. sugar and starch, 4-5 per cent. protein, and one-half to one per cent. of fat. Authors do not agree, however, on the essential point as to whether it contains sufficient vitamins, especially vitamin A, which is of such vital importance in the case of children. Experiments have been carried out on rats with very interesting results. The rats were put on a basic diet free from A vitamin until they began to lose weight and show signs of A-deficiency. The majority had very advanced xerophthalmia. They were divided into three groups: Group I received bananas *ad libitum* in addition to the basic diet; Group II received 1 grm. banana daily in the basic diet: Group III received 2 grm. banana daily in the basic diet. All the groups began to improve after a fortnight on the banana diet, especially with regard to the eye lesion. After three weeks there was an improvement in the general condition and the weight began to increase. The rats grew steadily until the end of the experiment, when they were fully developed. Group I increased most quickly and eventually attained the greatest weight, and Group III had a similar advantage over Group II. Two control series were made; in one the young rats received banana *ad libitum* with their basic diet from the first, while in the second they received their basic diet without banana. The second group soon fell sick and were all dead in seven weeks, but the first group thrived well.

The experiments show that the disease-preventing or healing component of the A vitamin in the banana is very active, while the growth-promoting component acts rather more slowly, but is present in sufficient quantity. If these results can be applied to man the banana may be regarded as an ideal food.

The Effects of "Castela nicholsoni" in the Treatment of Chronic Amœbic Dysentery (G. R. W. French and A. W. Sellards, *U.S. Nav. Med. Bull.*, August, 1924).—During 1923 seventeen cases of long-standing amœbic dysentery were treated in a naval hospital—all veterans of the Great War, who had been infected for periods varying from three to six years. Treatment was difficult; it consisted in the injection of emetine. *Castela nicholsoni*, however, proved of value; it can be easily and pleasantly administered by mouth, and when properly used is more effective than emetine. It is necessary to use potent extracts and to administer practically the maximum tolerated dose. The response in individual cases varies greatly, symptomatic relief being obtained in the majority. In eleven the stools became temporarily free from amœbæ, in five the infection persisted, and in six the effects of the drug appeared magical.

Observations on Bilharziosis in Iraq (A. Hislop Hall, *Journal of the Roy. Army Med. Corps*, February, 1925).—Bilharziosis is endemic in Iraq. It is widespread throughout the country and is not confined to the areas unaffected by the tide of the Persian Gulf. In Iraq it is always due to infection by *Schistosoma hæmatobium*. Its effect on the population both rural and urban is so marked that the disease must be considered an important factor in the economic development of the country. It is liable to spread to other countries. Anti-bilharzia measures hold out reasonable prospect of success and should be put into operation. For the success of such measures close co-operation is required between the departments of health, irrigation and education.

Malaria among Chinese University Students (K. H. Li, *China Medical Journal*, September, 1924).—Of 460 students of the Soochow University, 395 claimed to be, or to have been, malarious; 124 had clinical symptoms and were found to harbour subtertian parasites in twenty, tertian in ten, quartan in six, and undifferentiated forms in twenty-five cases. A students' strike confused conclusions, but malaria is held to be the most potent cause of loss of class attendance. Large mononuclears averaged 17·75 per cent.

Report on an Investigation into the Epidemiology of Sleeping Sickness in Central Kavirondo, Kenya Colony (G. D. Hale Carpenter).—The epidemic of sleeping sickness in Central Kavirondo was introduced about 1903 from Usoga across a chain of islands, and finally from Mageta Island to the coast of Kadimu close by. Mageta was evacuated, and subsequent return of the population brought back the disease, leading to a second evacuation, second return, and renewal of the disease about 1920-21, leading to a final evacuation for two years. *Glossina palpalis* occurs plentifully along the 100 miles of coast examined. Ample evidence was obtained that non-mammalian blood is much preferred to that of the hippopotamus, which was the only source of mammalian blood, except man and cattle at some localities. No trypanosomes were found in 238 *palpalis* examined. An interesting account is given of the history of the great epidemic in Central Kavirondo, Sigulu and Mageta Islands. During the recent investigations no cases of sleeping sickness were seen so advanced as to be obvious to the eye alone, and the majority of the several cases diagnosed seemed in their own opinion in good health. Only two of the emigrants from Mageta Island showed tremors of the tongue and some degree of wasting. So far as could be ascertained by inquiry, the disease is quiescent at the present time, the only deaths reported being among the Mageta people who had come away two years ago.

The presence of these infected people in a settlement on the mainland in close contact with Jaluo natives, of whom none have acquired the disease, is strong evidence that agents other than *Glossina* are not of material importance in the epidemiology of the disease. It was thought possible at one locality, where *Glossina* was reported to be unknown, that sleeping sickness must have been carried by some other agent, but close attention to local conditions and their history in the past showed that there was ample evidence that at the time of the epidemic *palpalis* was probably there in adequate numbers, although barely able to exist at the present day. Attention is drawn to the fact that broad contact between a population of density over forty per square mile and *palpalis* at the rate of more than fifteen males per boy per hour conduces to infection by *Trypanosoma gambiense*.

Complaints of Patients under Anti-leprosy Treatment, I. Nature and Frequency in Cases Receiving Chaulmoogra Ethyl Esters Preparations (W. H. Wade, C. B. Lara and C. Nicolas, *The Philippine Journal of Science*, December, 1924).—Few conclusions are to be drawn from this paper, both because of its general nature and the influences affecting the data, though several points of interest are seen. The importance of complaints of patients in modifying the methods of treatment is emphasized. Their kinds and classification are discussed and so far as possible their relative frequencies as met with in the Culion Leper Colony. The sex of patients has no apparent influence on the number of patients complaining. Age has little relation to the total number of complaints, but local irritation is apparently most frequent in the youngest and most of the other conditions least frequent. Coughing and choking and lepra reactions are most frequent in the aged. Wide variations in the reports of the individual physicians prevent the drawing of conclusions as to the effect of different tendencies in administering medication. It is found that on the average the amount of medication given during the period involved was decidedly not intensive. Analysis of the general relation of treatment methods to complaints shows little of the natural relationship between dosage, &c., and frequency of the various complaints, indicating clearly that the treatment staff as a whole has been careful to modify the administration of the drug to the side-effects produced, particular attention having evidently been paid to the dangerous respiratory tract symptoms and to lepra reactions.

Complaints of Patients under Anti-leprosy Treatment, II. Comparison of Plain Chaulmoogra Ethyl Esters and Two Iodized Preparations (H. W. Wade, *The Philippine Journal of Science*, December, 1924).—The plain chaulmoogra ethyl esters are irritating, particularly to the tissues at the point of injection and to the respiratory tract, so much so as seriously to limit the intensiveness of treatment with it in a leper population such as that of the Culion colony. Iodized preparations of the ethyl esters are much less irritating locally, which permits their more intensive use, and they also cause fewer complaints of general symptoms. The 2 per cent. iodized ethyl preparation,

heretofore generally used, has, according to the data examined, certain minor but not insignificant disadvantages over the plain drug. The 0·5 per cent. iodized preparation is in several respects distinctly superior to the 2 per cent. and, unlike this, in no important way compares disadvantageously with the plain drug. It is, therefore, the best of the three for routine anti-leprosy treatment.

Height, Weight and Chest Measurements of Mongolian Peoples, with Especial Reference to Southern Chinese (Wm. W. Cadbury, *The Philippine Journal of Science*, December, 1924).—The Chinese people average 165 centimetres in height. The people living south of the Yangtze River, in general, are shorter in stature than those north of this river. For Cantonese students of twenty years or over, the average height is 163·6 centimetres. The weight of the Chinese averages 56·9 kilograms in the north and 52·6 kilograms in the south. For Cantonese students of twenty years and over, the average is 51·9 kilograms. Taking the weight-for-height index as a criterion the index is found to vary from about 313 in the south to 384 in the soldiers of the north. For Cantonese students it averages 317. These figures are much smaller than the averages for Americans and Europeans. The chest circumference of Chinese is relatively small, varying from 77·4 to 86·9 cm. For the students in South China, the average circumference of the chest during rest is 78·9 cm. and they have a play of chest of about 6 centimetres. The Southern Chinese are therefore inferior to their northern brothers in height, weight, and chest measurements. The Mongolian tribes of the far North and the peoples of Indo-China to the south are inferior in size to the Southern Chinese. Because of the great tendency of the Cantonese people to travel and their intermarriage with the Malay peoples it can be assumed that this admixture has had much to do with producing a smaller race of Chinese. On the other hand, the author has observed that they are capable of developing almost the same degree of muscular energy and physical endurance as are the larger races of mankind.

Studies in Addison's Disease (L. Browning, *Journal of American Medical Association*, January 31, 1925).—In this report emphasis has been placed on the improvement accruing under forced organotherapy. The results have exceeded expectations in several instances. On the other hand, in spite of thoughtful and continuous efforts, five of the twelve patients died under treatment. The prognosis in Addison's disease is very grave. Only in a certain proportion of the cases can marked or lasting improvement be expected or obtained. At best, the treatment can only combat functional insufficiency of the suprarenal glands. If this is the outstanding factor in the disease, a form of substitution or complementary treatment may prove of decided value. The treatment probably exerts no influence on the fundamental pathologic processes underlying the Addisonian manifestations. Since nothing better is available, the Muirhead treatment should be given a fair trial in every case of Addison's disease, care being exercised, however, to see that the patient's individual tolerance is determined and given due consideration, and that simultaneously every measure is utilized in combatting the associated symptoms and the underlying pathologic process.

The Skin Capillaries in Raynaud's Disease (G. E. Brown, *Archives of Internal Medicine*, January, 1925).—The skin capillaries in eight cases of Raynaud's disease were studied during the different colour phases exhibited by this disease. In the normal compensated periods, many of these vessels disclose evidence of disturbed capillary tone, abnormal flow or complete stasis. The degree in which these abnormalities exist determines in a large degree the colour of the skin. The stage of syncope reveals many empty or partially filled contracted loops with stasis. The period of asphyxia is due to refilling of the capillary loops from segments of arterial or venous blood, or both, and dilatation of the loops with varying periods of stasis which determine the degree of cyanosis. The longer the cessation of capillary flow, the more pronounced is the capillary dilatation, and the greater the carbon dioxide content of the capillary blood. The recovery or rubor phase is due to resumption of capillary flow, more complete opening up of capillaries, pressure of oxyhæmoglobin, and partial recovery of capillary tone. Additional evidence is presented to prove the existence of independent behaviour of the skin capillaries.

The Treatment of General Paralysis by Malaria (T. Wishart Davidson, *British Medical Journal*, March 7, 1925).—The conclusions of this article are that the malaria treatment of general paralysis is justifiable and hopeful, provided the patients are in fair physical health. The earlier the case the better the prognosis. The treatment is contra-indicated where the patient is likely to have a fatty heart or where there is poor physical health. It may be added that the administration of strychnine, with digitalin or strophanthin to steady the heart, is advisable and helpful, especially during the later pyrexial attacks. Relapses of malaria do occur, but practically only in mosquito infected cases. Compared with infection by the inoculation of trophozoites, it would appear that infection by the sporozoites from the mosquito produces a parasite which readily becomes resistant to the immune body, and thus relapses frequently occur. A previous attack of malaria would appear to induce partial immunity; although scanty parasites appear in the peripheral blood there is no rise of temperature.

Primary Carcinoma of the Lungs (B. M. Fried, *Archives of Internal Medicine*, January, 1925).—Primary carcinoma of the lungs is apparently much more frequent than is commonly believed. Because of the similarity, from the clinical point of view, of

primary lung cancer and a great many chronic lung infections, and particularly chronic pulmonary tuberculosis, primary malignancy of the lungs is often mistaken for phthisis or other lung disease. Primary carcinoma of the lungs possesses a vigorous metastatic power. From the cases here reported, it seems that the tumour metastasizes very early, and the bones and brain are apparently much more frequently involved than is generally recognized. The bones may be infiltrated with tumour without producing any change in the outward structure. Because of this property (early metastasis) the chief symptom of the patient, as well as the attention of the clinician, is concerned with the secondary involvement, while the primary lesion is often overlooked. In any case of chronic lung affection with an atypical course and persistence of symptoms, especially if tuberculosis is excluded, malignancy should always be considered. The presence of pulmonary tuberculosis does not exclude the coexistence of malignancy in the same organ.

Focal Infection in Peptic Ulcer (R. L. Haden and P. T. Bohan, *Journal of the American Medical Association*, February 7, 1925).—In the case reported, experimental proof of a causal relationship of chronic foci of infection to an existent peptic ulcer was obtained by the injection into animals of bacteria recovered from the focus. In twelve patients, dental infection was probably the primary cause. Forty-five rabbits were injected with cultures from dental foci in three patients; 53 per cent. of the animals showed peptic lesions at necropsy. Only seven per cent. of 535 control animals similarly injected had such lesions. Eleven rabbits were injected with the cultures from the tonsils of five patients. Ten showed at necropsy lesions of the stomach or duodenum. The duodenal lesions that are observed experimentally are limited to the duodenal bulb, just as they are in man. The gastric lesions have a similar anatomic distribution. The evidence presented is good proof of the infectious theory of peptic ulcer. Patients with peptic ulcer should be thoroughly studied from the standpoint of chronic infection, and all possible foci removed. Gastroduodenal malfunction without demonstrable focal lesions may likewise be a manifestation of focal infection.

Mycotic Paronychia and Dermatitis (L. B. Kingery and C. H. Thienes, *Arch. of Dermatology and Syphilology*, February, 1925).—This condition has not been hitherto described, and is apparently peculiar to fruit canners. It is commonly known as "fruit poisoning," and has existed in certain sections of North-west America for a number of years. Cultures from several patients have uniformly revealed pure cultures of a yeast-like organism. Animal and human inoculations with organisms thus obtained result in a clinical picture practically identical with known mycelial infections of the skin, and exactly corresponding to the symptoms of patients suffering from the disease.

Painful Nodular Growth of the Ear (O. H. Foerster, *Arch. of Dermatology and Syphilology*, February, 1925).—The remarkable uniformity in the clinical symptomatology, as well as in the histologic features of the cases of painful nodule of the ear recorded thus far by Winkler and Foerster, indicates that the condition is an entity. It is readily differentiated from epithelioma, keratosis and other conditions which may resemble it, on the basis of both clinical and histological characteristics. The ætiology is unknown, although the anatomic peculiarities of the part of the ear almost exclusively affected are suggestive of the pathogenesis of the condition, and lend support to the foreign-body theory advanced by Winkler.

Melanosis after Arsenobenzol (W. J. O'Donovan, *Brit. Journ. of Dermatology and Syphilis*, February, 1925).—The long-continued oral administration of arsenic is admitted to cause in rare instances a melanosis of the skin. This melanosis has special features of widespread distribution and circular white spots. Acute oral intoxication by arsenic may produce exfoliation and pigmentation. Minute doses of arsenic are sometimes sufficient for the production of melanodermia, although as a rule prolonged absorption, medicinal, occupational or accidental is responsible. A case is reported of grave and persistent melanosis after eleven doses of neo-salvarsan that is closely similar to the described cases of arsenical melanosis of the pre-salvarsan period.

Epidemiological Studies on Respiratory Infections of the Rabbit. VI. Ætiology of Otitis Media (D. T. Smith and L. T. Webster, *The Journal of Experimental Medicine*, February 1, 1925). — A common form of otitis media occurring in rabbits is described. The condition in the great majority of instances is associated with the inflammation of the upper respiratory tract known as snuffles and with the presence of *Bacterium lepisepticum*. This organism, when introduced into the external nares of rabbits hitherto protected from infection with it, is capable of inducing a purulent otitis media indistinguishable from the natural one. In the rabbit the connection between the nasal passages and the middle ear is such that a pathogenic agent introduced into the nose may readily invade the entire group of cavities connected with the upper respiratory tract.

The Influence of the "Diaplyte" Antigen of Dreyer on Tuberculosis of the Guinea-pig (J. J. Bronfenbrenner and E. L. Straub, *The Journal of Experimental Medicine*, February 1, 1925).—The writers have prepared "diaplyte" antigen according to Dreyer's procedure, and have studied its therapeutic and prophylactic value in experimental tuberculosis of guinea-pigs. In their hands it has failed to yield beneficial effects. The animals treated with the antigen tended in general to develop lesions more quickly and to die earlier than the controls.

Contributions to the Pathology of Experimental Virus Encephalitis. (2) "Herpetic Strains of Encephalitogenic Virus" (S. Flexner and H. L. Amos, *The Jour. of Exper. Med.*, February 1, 1925).—In this paper it is shown that unequivocal strains of herpes virus exist in man, which in the rabbit exhibit a degree of encephalitogenic power not exceeded, and perhaps rarely equalled, by any strain of the so-called encephalitis virus. The fact that such highly encephalitogenic strains of the herpes virus exist in nature has, at the moment, theoretical and practical importance. Until recently the view has been accepted by certain workers in the field that two biologically distinct viruses of this class occur—one including epidemic encephalitis and the other febrile herpes in man.

Abstract.

AGGLUTININ FORMATION FOLLOWING THE USE OF CASTELLANI'S GLYCERO-VACCINE.[1]

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ONE of the difficulties encountered by the Philippine Health Service in its work is the complete administration of the three standard injections for immunization against cholera or typhoid in campaigns, particularly provincial campaigns. This is due to lack of trained personnel, long distances between houses, and, most important of all, the tendency of the people to avoid succeeding injections after having received the first one. Preliminary experiments were made to note the presence or absence of agglutinins following one injection of the usual vaccine (1 c.c. = cholera, 1,000 million; *B. typhosus*, 500 million; *paratyphoid* A, 250 million; *paratyphoid* B, 250 million). Ten prisoners from the municipal jail at Zamboanga were injected with 1 c.c. of saline anticholera typhoid vaccine. Only one showed agglutination with cholera vibrio in 1 to 10 dilution after one month of observation.

Failing to obtain satisfactory anticholera agglutinin formation by the use of this vaccine, we were tempted to investigate agglutinin formation by the use of a single dose of Castellani's vaccine. Although agglutinins are by no means the only indication of immunity, still, the study of this phase was the best we could do with our facilities. The vaccine used was prepared as follows:—

Seed.—Two strains of cholera vibrio from the Manila epidemic of 1919; two strains of *B. typhosus* from the University of the Philippines, 1920; *paratyphoid* A and B from the Army Medical School, 1918.

Culture.—Plain nutrient agar using meat extract, reaction to phenophthalein about 0·5 per cent. to 1 per cent. acid. Put up in litre flat pharmacy small-necked bottles containing about 150 c.c. of agar; when slanted a maximum agar surface of about 170 cm.[2] is presented.

Inoculation.—Standard twenty-four-hour agar slant of the seed was emulsified in ·15 c.c. of saline and each bottle inoculated with 5 c.c. of the emulsion, the agar surface covered by tilting, and the bottles incubated at room temperature (30° C.); 4 bottles were inoculated with cholera vibrio, 2 bottles with *B. typhosus*, and 1 bottle with *B. paratyphoid* A, and 1 bottle with *B. paratyphoid* B.

After twenty-four hours at room temperature the growth in each bottle was emulsified in 125 c.c. sterile saline, mixed in a sterile litre bottle and well shaken.

Standardization.—Wright's method and opacity method; 1 c.c. of the mixture to contain 8,000 million (cholera 4,000 million; *B. typhosus*, 2,000 million; *paratyphoid* A, 1,000 million; *paratyphoid* B, 1,000 million) approximately; preservation, 0·5 per cent. phenol, 2 per cent. glycerine.

Water Bath.—Fifteen to twenty minutes at 60° to 65° C. Tested for sterility by culture and animal inoculation.

Bottling.—Passed through sterile bottling set with sterile gauze filter into sterile bottles and stoppered with sterile corks.

Dose.—One c.c. for adults. Children, according to age and development (under 5 years, 0·5 c.c.; 11 to 15 years, 0·75 c.c.).

TECHNIQUE OF THE TEST.

At least one capillary drop of serum was obtained by the usual method and mixed with nine capillary drops of normal saline solution. From this other dilutions of 1 to 20, 1 to 40, &c., were made. Fresh eight to twenty-four-hour old cholera slant was used for the test by making a slightly turbid suspension of this in normal saline solution. One loop of this added to one loop of the 1 to 10 serum dilution gave a final dilution of 1 to 20, &c. The test was observed under the microscope and controlled with or without normal serum in a separate hanging drop. Observations were made at room temperature (about 28° to 30° C.) after one hour.

The sera of 43 student nurses and attendants of the Zamboanga General Hospital were first examined for anticholera agglutinin and all were found negative in 1 to 20 dilution at room temperature, after one hour. They were then injected subcutaneously with 1 c.c. of the above-mentioned vaccine. The reactions in all of them were swelling of the arm with heat, pain and redness. Headache and indisposition were present in about one-third of the cases. Slight fever (37·5° to 38° C. per axilla), lasting from one to five hours in five cases. One chlorotic girl had to be admitted to the hospital for two days due to fever (37·5° to 39° C. per axilla) and weakness. With the exception of this one person, all continued at work.

The sera was tested against cholera vibrio every day during the first ten days, every two days during the following ten days, and once a week thereafter, using 1 to 20, 1 to 40, and 1 to 80 dilutions. These observations were continued for 160 days and the following results were noted. In 6 of the 43 cases no agglutination in 1 to 20 dilution was found. Thirty-seven cases showed positive agglutination at

[1] Abstracted from the *Philippine Journal of Science*, March, 1925.

some time. The appearance of positive reaction, in days, after injection is shown in Table I.

TABLE I.

Days after injection	Cases
6	1
8	1
9	1
10	15
12	9
14	2
15	1
21	3
29	1
39	1
48	1
80	1
Total	37

Table II shows the persistence of agglutinin in 20 positive cases which became negative in 1 to 20 dilution, during 160 days' observation.

TABLE II.

Days	Cases
14	1
19	1
27	1
30	3
51	2
80	6
120	6
Total	20

Table III shows the maximum titre of sera attained during observation.

TABLE III.

Dilution	Cases
1 to 20	15
1 to 40	15
1 to 80 or more	9
Total	37

SUMMARY.

A single dose of 1 c.c. of Castellani's glycero-vaccine (cholera, 4,000 million; *B. typhosus*, 2,000 million; *paratyphoid* A, 1,000 million; *paratyphoid* B, 1,000 million) produced anticholera agglutinin in 37 of 43 vaccinated persons.

Of the 37 positive cases, agglutinins appeared in 24 cases between the ninth and fourteenth days after the single injection.

Six cases remained negative for 160 days of observation.

Of the 37 positives, in 20 cases agglutination became negative in dilutions of 1 to 20 within 160 days after vaccination.

In more than 50 per cent. of these cases agglutinins were present in the blood of vaccinated persons for a period of three to four months.

The formations of agglutinin observed in the blood of persons vaccinated with Castellani's glycero-vaccine were more satisfactory than those obtained with the usual saline vaccine when used in single 1-c.c. doses (cholera, 1,000 million; B. *typhosus* 500 million; *paratyphoid* A, 250 million; *paratyphoid* B, 250 million).

The reactions, both local and general, were practically the same as those from saline vaccine, considering the number of bacteria given.

This vaccine was given to at least 40,000 people and not a single mishap was reported.

Current Literature.

BULLETIN DE LA SOCIÉTÉ DE PATHOLOGIE EXOTIQUE, March 11, 1925.

Experiments of Antiplague Vaccination by the Mouth in Man (G. Raynal).—These experiments of vaccination *per os* were carried out during an epidemic of bubonic plague at Diego-Suarez during the months of July, August, September, 1924. Although the epidemic was a small one, the mortality was very high. The vaccine used was "Pestedo" and the results were very good. There were no intestinal or general reactions in any of the cases. The number of tablets taken by each patient was seven per day. These results call for further experiments on a larger scale.

Experiments of Antimeningococcal Infection in the Belgian Congo (F. Van den Branden).—Experiments carried out during the war with antimeningococcal vaccine did not give very satisfactory results. In 1923, however, Calbraic obtained excellent results in an Annamite contingent. In 1924, at the beginning of the dry season, an epidemic broke out at Stanley Pool of cerebro-spinal meningitis; thirteen cases due to meningococcus and ten cases to pneumococcus. All the natives of both sexes were given prophylactic injections of antimeningococcal vaccine according to age. The injections were administered either subcutaneously or intramuscularly; there were no appreciable local or general reactions. Nearly two months later thirteen more cases were detected; three due to meningococcus and ten to pneumococcus; of the first three one had not received injections, and the other two who had, quickly recovered. These results undoubtedly prove the value of antimeningococcal vaccine.

A Case of Dercum's Disease affecting the whole body except the Face, Hands, and Feet in a Native Woman of Morocco (Mme. E. Delanoe).—The patient was aged 40 to 45. She was an enormous size, and could hardly walk without balancing herself with her arms. She complained of pains all over her body which were almost insupportable at night; very often she could not sleep. The joints were the parts most painful, especially the small ones; headaches were continuous, and were also worse at night time. The patient believed the condition to be of syphilitic origin, and asked for intravenous injections. About twenty-five years ago she had contracted syphilis of a very severe type; there was a generalized eruption fever, and headaches. The eruption left a slight swelling all over the body, which had gradually increased, and had never ceased. Under iodide treatment the eruption disappeared and the pain ceased. When the pain returned the patient had recourse to iodide. She is now improving rapidly under injections of neoarsenobillon.

"Clou de Biskra," observed in the Neighbourhood of Algiers (J. Montpellier).—Report of three further cases of oriental sore near Algiers proves that the malady is more widespread than is generally believed. Attention is drawn to the likeness of oriental sore to cutaneous tuberculosis, which is the cause sometimes of diagnostic errors. In these cases a peculiar crust was observed, which is described, and to which the author thinks more attention should be given, as it is a very useful factor in diagnosis.

Secondary Infection of the Uterus post partum by Chilomastix mesnili (R. Pons).—*Chilomastix mesnili* is a parasite frequently found at Saigon in the stools at laboratory examination. In this case, however, the infection had made its way to the genital tract, vagina and uterus, after a confinement. The patient was of robust constitution and the mother of two healthy children. She had been suffering from dysentery about three years before giving birth to another child, but during this interval had regular attacks of serous diarrhœa. Two days after the child was born, fever set in and diarrhœa. Examination showed the presence of numerous flagella in the stools and lochia, identified as *Chilomastix mesnili.*

On the Culture of the Intestinal Protozoa (W. L. Yakimoff, Mlle. W. J. Wassilewsky, and Mlle. N. A. Zwietkoff).—Cultures of several protozoa of the intestine of man and laboratory animals have been obtained on Frosch-Schardinger gelose medium. With this medium cultures can also be obtained of protozoa of the earth, water, hay, straw and grain, but it is preferable to make the first culture on ordinary diluted broth. There are some protozoa, however, which are not cultivable on Frosch-Schardinger gelose: *Lamblia, Chilomastix, Trichomonas, Octomitus, Trichomastix.*

On the Existence of Ankylostomiasis in Turkey (Akil Moukhtar and Sedad).—A second case is reported of ankylostomiasis at Constantinople; the first was described by Vassif Bey. Both patients were peasants working in the fields and had never followed any other occupation.

THE INDIAN MEDICAL GAZETTE, April, 1925.

Clinical Studies on Digitalis in Bengal (S. C. Bose).—Over 150 cases of heart failure have been clinically studied, of which a large number were in imminent danger. Of these only 6 per cent. of cases had auricular fibrillation, while 94 per cent. had normal rhythm starting at the sino-auricular node. On the contrary, over 66 per cent. of all cases of heart failure in Europe and America have auricular fibrillation. Standardized tinctures obtained direct from Parke, Davis and Co. were used in almost all the cases, in preference to other preparations of digitalis. The average quantity of tincture necessary to induce toxic effects varies in cold countries from 4 to 7 fluid drachms. In Calcutta the smallest dose required was 9 drachms, the highest was 29 drachms, and the average dose was well over 14 drachms. This result is partly due to loss of potency of tincture and partly to increased decomposition in the alimentary tract and liver. To obtain prompt results in grave cases, the tincture has been used, and ought to be used in doses of 2 to 3 drachms per day for five days. Cases of failure with normal rhythm require nearly the same dosage as cases with auricular fibrillation. Cases of failure, with free aortic regurgitation, syphilitic myocarditis and a strongly positive Wassermann reaction, do not benefit permanently from digitalis. Senile hearts, cases of marked hypertension and cases of grave anæmia with fatty degeneration of the myocardium respond remarkably well to digitalis.

The stage of optimum benefit from digitalis usually merges into the stage of minor intoxication from cumulation of the drug. With the tincture as obtained in this country it is extremely rare to get toxic effects from the use of tincture of digitalis in B.P. doses of 15 minims thrice daily.

The toxic effects such as slowing of the heart rate, nausea, vomiting and diminished diuresis often come on almost simultaneously, and after massive doses of 2 drachms a day have been taken for more than seven days. Apart from slowing digitalis may rarely provoke a sudden paroxysmal tachycardia of 180 p.m., termed "digitalis tachycardia."

Combined Carbon Tetrachloride and Oil of Chenopodium in the Treatment of Hookworm Disease. A Report of the Treatment of Seventy Cases (Asa C. Chandler and A. K. Mukerji).—From results obtained by these experiments the authors do not think that the addition of chenopodium to carbon tetrachloride is of any value in pure Necator infections, but the evidence, so far as it can be judged from a small number of cases, is strong that the combined drugs have a considerably more powerful effect on ankylostoma than has either drug alone. In places where ankylostoma and ascaris infections are common, therefore, a combination of carbon tetrachloride and oil of chenopodium is the best anthelmintic to use. This has also been proved by various other authors. The dosage employed of 60 minims of carbon tetrachloride in milk and 15 minims of oil of chenopodium in a capsule is considered safe for controlled patients; for field work on a large scale a smaller dose of these drugs in the same proportions is recommended. It is significant, however, that the fatal cases of carbon tetrachloride poisoning have always followed small doses, indicating that the condition and diet of the patient are more important factors than the size of the dose.

The Treatment of Cholera by Cresol and Acid (F. J. Palmer).—The author has found that cresol in association with acid in the treatment of cholera is superior to cresol alone. So far only nine cases have been treated but the results have been quite promising. The dose of acid is a small one, and graduated in view of the greater liability of children to acidiosis. It is essential that the doses should be freshly made to obtain good results.

Is Trichomonas hominis Pathogenic? (P. Ganguli).—Opinions have varied as to the pathogenicity of *Trichomonas hominis* ever since its discovery in 1854 by Davaine. Dobell, O'Connor, Knowles and other protozoologists believe that this protozoon is not pathogenic. Ganguli, for the following reasons, is of the opinion that *T. hominis* is pathogenic:

(*a*) Out of forty-three cases in which trichomonas was found in human stools in Eastern Bengal, no less than thirty-six were suffering from either diarrhœa or dysentery. Stools of three such dysentery cases were "plated" but no colony of dysentery bacilli was discovered. Seven cases with normal-formed stools showed motile trichomonas. These cases are considered *carriers* in analogy with *Entamœba histolytica* carriers. Just as some persons may harbour *E. histolytica* without showing any signs of dysentery, so trichomonas may be found in persons passing healthy stools. (*b*) Trichomonas has been found to contain red blood-cells. No other non-pathogenic intestinal flagellate has been found to have ingested the red blood-cells. (*c*) Trichomonas infestation can easily be removed with large doses of oil of turpentine given with castor oil emulsion. Patients showing *E. histolytica* in their stools in addition to trichomonas require emetine as well. (*d*) In two cases passing dysenteric stools, both *E. histolytica* and trichomonas were found. The pH of both the stools was 6·8. In nearly all the cases the reaction of the stools showing trichomonas was distinctly alkaline; but in these two cases, although the reactions of the stools were acid, the flagellates were found to be as active as ever.

Trichomonas Infection in the Urine (S. K. Ghosh Dastidar).—*Trichomonas hominis* infection of the intestine and *Trichomonas vaginalis* infection have been described by several writers, but this is apparently the first description of trichomonas infection in the urine. In routine examination of some thousand specimens of urine of both sexes, the author recently encountered this parasite in four individuals—three males and one female. All the samples were collected in clean glass urinals, so that there can be no question of fæcal contamination. It would appear that trichomonas may cause a mild urethritis, attended with smarting and burning on micturition, or the discharge of pus *per urethram*, but that this urethritis is cured on the disappearance of the trichomonas.

On the Technique and Significance of the Rosindole Reaction, applied to Urine (A. Neave Kingsbury and K. Kanagarayer).—The authors describe a technique for the application of the Rosindole test to urine. A positive result does not indicate presence of indican in the urine. An interesting point is that the percentage of positive cases is decreased in nephritic cases and increased in liver and insufficiency cases.

Intravenous Injections of Sodium Iodide in the Treatment of Goitre (E. A. Davis and P. Bell).—Interesting results have been obtained by the administration of intravenous injections of sodium iodide in cases of goitre; 5-6 gr. intravenously is tolerated well without any reaction, in a solution of 1 gr. to 1 c.c. of distilled water. It remains to be seen whether, after the the goitre has been reduced to normal, it will remain so or whether it will recur. So long as the patient remains in his original surroundings it will probably recur, at least in the great majority of cases. After a cure the patient should be removed to a more suitable place with a varied diet. If sodium iodide could be issued in tablet form it would be more convenient for several reasons. A chemically pure supply of the drug is necessary for intravenous injections to ensure safety. Further observations on this subject will be published later.

Medical News.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE.

DIVISION OF TROPICAL MEDICINE AND HYGIENE.

Examination Result, 78th *Session*, *April-July*, 1925.

Distinction: A. McKenzie (winner of "Duncan" Medal), H. E. Meleney, K. A. T. Martin, E. A. Seagar, W. E. Corner, T. F. Sheehan, G. S. P. Noble, C. R. Philip, G. Waugh Scott, A. M. Said.

Passed: W. Wilkinson, H. D. C. Rice, Hans-Raj, J. C. R. Buchanan, J. W. Field, C. Sturton, Miss C. A. Stuart, A. Ramakrishnan, F. M. Halley, M. L. Chang, Miss G. Lowe, D. Drysdale-Anderson, M. Burn, R. Comty, J. S. Armstrong, L. Blake, F. H. King, R. Mackay, I. M. R. Pilot, S. W. Eveson, Miss I. Keess, E. G. H. Payne, Y. Y. Ying, W. Nelson, C. Wilson, D. M. McSwan, M. S. Mahmood, B. O. Wilkin, J. H. Pasqual, C. F. Maclean, A. Malchi, L. A. Willmott, W. K. McCandliss, H. J. O'D. Burke-Gaffney, J. H., Owen-Flood, S. R. P. Montgomery, G. W. Harley, W. J. Moir, J. R. Davies, Miss D. Durance, J. A. Ahlquist, Miss M. E. Bennet, C. S. Wilson, Miss W. D. Cargill, M. J. Marren, Hannah Khouri, S. M. Ali, M. Chandra, H T. Chiang, C. B. Macleod, H. A. Rahmeh, A. F. R. Dove, M. Rodriques, I. G. Soliman.

Correspondence.

To the Editor of the JOURNAL OF TROPICAL MEDICINE AND HYGIENE.

SIR,—In regard to the common South African host for the *Bilharzia* parasites, although Professor Ferdinand Krauss originally described the species as *Physopsis africana* and is therefore entitled to have the brackets omitted from his name, the species is now being described as *Isidora* (*Physopsis*) *africana* (Krauss), as will be seen from Major M. Connolly's well-illustrated description of "The Non-Marine Mollusca of Portuguese East Africa," published in the *Transactions* of the Royal Society of South Africa, volume xii, part 3, 1925, where some interesting details are also given to enable us to differentiate the species from *Isidora* (*Physopsis*) *globosa* (Morelet) which I have found infested with two distinct schistosomes at Lourenço Marques, and which is believed to be the common host for the *Bilharzia* parasites right across the African Continent from Portuguese East Africa to the Gold Coast and Sierra Leone.

Yours faithfully,

F. G. CAWSTON, M.D.

June 22, 1925.

Original Communications.

STUDIES OF THE YELLOW FEVER EPIDEMIC IN SALVADOR, C.A., IN 1924.

By HENRY R. MULLER, M.D., and C. BYRON BLAISDELL, M.D.
Special Members, Field Staff, International Health Board, The Rockefeller Foundation.

DURING June, July, August, September, and October of 1924, an epidemic of yellow fever occurred in San Salvador, the capital of the Republic of Salvador, C. A. The diagnosis was made from the clinical symptoms and from the autopsy findings by the local physicians (Segovía, Lardé) and by members of the Rockefeller Commission (Molloy, Bailey, and Hanson). Altogether there were fifty-six recognized and recorded cases of yellow fever of which fifteen were fatal, but the total number of cases is difficult to ascertain exactly. At least five cases occurred in a barracks among soldiers and many in the Casa Presidential, in the hotels and houses within a radius of one or two blocks from the barracks. Although the first recognized case was in a man of German birth who became sick on June 5 and died on June 9, subsequently about fifty cases occurred in natives of Salvador or other central American countries. It is estimated that about 1,500 foreigners (British, French, Germans, Americans, Syrians and Chinese) live in San Salvador. That so many natives were affected is partly explained by the fact that many of them were non-immunes from the interior of the republic who had recently come to live in the capital, San Salvador, after having previously resided in the rural districts where yellow fever had not existed.

During the latter part of the epidemic, cases of yellow fever were reported in other parts of the republic, but these outbreaks were relatively small and all occurred in the western part of the country. For instance, in the city of Ahuachapan (eighty miles west of the capital), twenty cases, eight of them fatal, were reported as suspicious of being yellow fever between August 1 and October 16. Also in Chalchuapa (twenty miles from Ahuachapan) between September 17 and October 5, six suspicious cases, with three deaths, were reported.

Unfortunately, we arrived in Salvador a month after the last case of yellow fever was recorded in the country (November 13, 1924), hence we had to content ourselves with a study of such materials as could be gathered from the cases which had occurred earlier. Dr. Juan Segovía, the Director of the Public Health Department of Salvador, Dr. Lardé, the chief of the Anti-Larval Division of the Public Health Department, and Dr. Parada, Chief of the Laboratory of the Public Health Department very kindly turned over to us what could be obtained in the way of histories, autopsy protocols, autopsy tissues, and sera from convalescents and normal individuals. The facilities of the laboratories of the Dirección Géneral de Sanidad also were placed at our disposal. To Dr. M. E. Connor, of the Rockefeller Commission for Yellow Fever Control in Central America, too, we are thankful for constant help and attention.

We directed our attention, first, to a study of the Pfeiffer phenomenon with sera from convalescents. Supplementary to the Pfeiffer reaction in convalescents we carried out similar tests with the sera from groups of normal adults, normal children and individuals vaccinated against yellow fever. Next we studied the histopathology of yellow fever as it occurred in Salvador.

(I) PFEIFFER REACTIONS WITH THE SERA OF YELLOW FEVER CONVALESCENTS AND OF NORMAL INDIVIDUALS.

Through the kind efforts of Drs. Segovía, Lardé, and Parada, blood was obtained from individuals who had recovered from clinically well defined or clinically suspicious yellow fever during the epidemic of 1924. The sera from these cases were tested against virulent, living cultures of *Leptospira icteroides* in the following manner:—

A mixture consisting of 0·5 c.c. serum, 0·5 c.c. pure culture (taken from the surface of a growth on the usual "Noguchi leptospira medium," and 1·5 c.c. of 0·9 per cent. saline was immediately injected into the peritoneal cavity of normal, medium sized guinea-pigs (200 to 300 grm.). At intervals of twenty or thirty minutes, for a period of two hours, samples of the injected liquid were withdrawn from the peritoneal cavity with capillary pipettes and examined by means of a dark-field microscope. Control tests with the saline solution used and with sera from normal individuals, never exposed to yellow fever, were performed. Since it has been shown [1] that the various strains of *L. icteroides* obtained from Ecuador, Peru, Mexico and Brazil, are equivalent for this test, they were used indiscriminately. Most of the individual tests were repeated. It has also been repeatedly shown that the lytic substances present in the blood after an attack of yellow fever are specific against *L. icteroides* [1].

As indicated in Table A, of twenty clinically suspected or definite cases of yellow fever occurring in the city of San Salvador during 1924, sixteen gave definite positive Pfeiffer reactions, i.e., lysis of the leptospira within a period of two hours. Usually lysis took place in half an hour. One doubtful result was obtained in Case 10 which was clinically a positive case of yellow fever. Of the three negative cases, Case 24 was either not yellow fever or was aborted on the first day by the use of serum. Excluding this case we obtained 84 per cent. positive Pfeiffers in nineteen clinically positive cases of yellow fever.

It has been extremely difficult to get reliable histories from the cases of Chalchuapa and Ahuachapan, and as the specimens of blood were exposed to the rather warm ambient temperature for three days before they reached the laboratory it is possible that the sera may have been altered in their activity. Sera were obtained from five cases and only two gave positive results (Table B). These tests were repeated, with the same result each time. It is quite likely that many of the suspicious cases in these two towns were not yellow fever; for instance, in Case 27 the patient herself gave us a history which was not very

suggestive of yellow fever (see Remarks, Table B). In Case 30 also the history states that malaria organisms were found in the patient's blood during her illness, hence this case may have been a severe form of malaria. The sera from these cases gave negative Pfeiffer reactions.

With a view to determining whether certain individuals who had apparently remained well during the epidemic had nevertheless passed through a mild form of the disease without recognizing it, sera were obtained from a group of normal soldiers living in the barracks, where several cases occurred. Of the fifteen individuals (Table C), fourteen gave clear-cut negative results, and one a mild positive result. In this last case (Case 25), however, a vaccination, carried out either in August or September, 1924, may have been responsible for the mild positive reactions. However, negative results were obtained with the sera of three individuals of this same group who had been vaccinated 130 to 160 days previously (exact date is not available). The tests in this group were all performed between January 12 and 19, 1925, i.e., not more than six or seven months after the first recorded case of the epidemic of 1924. From past experience [2 and 3], we would expect the serum still to give a positive reaction if the individual had had the disease within this period, even though in a mild or unrecognized form. As already stated, among fifteen soldiers that were examined, no such clinically unrecognized types of the disease were detected by means of the Pfeiffer reaction.

It has been suggested that between epidemic periods the virus of yellow fever may be maintained in children who have the disease in an atypical form, so mild that it has hitherto not been recognized. It has been thought possible that such cases also

TABLE A.—PFEIFFER TESTS WITH SERA OF YELLOW FEVER CONVALESCENTS IN SALVADOR, 1924.

(Suspicious and definite cases.)

Case number	Name	Date of onset	Date of Pfeiffer test	Number of days between illness and test	Result of Pfeiffer	Remarks
7	E. de G.	2/5/24	12/12/24	224	+	Black vomitus; jaundice; albuminuria.
8	E. G.	9/6/24	12/12/24	186	+	Had much black vomitus; albuminuria late.
9	I. V.	15/6/24	14/1/25	213	−	Mild chills and fever, headache, backache, pains in legs, bilious vomiting; sick for 5 days; became jaundiced in last days of illness. Rapid recovery.
10	J. C.	18/6/24	11/12/24	176	±	Is father of Case 8. Less severe than Case 8.
11	M. C.	18/6/24	11/12/24	176	+	Typical case.
12	A. E.	29/7/24	4/12/24	128	+	Typical case with black vomitus; melæna, icterus, albuminuria and cylindruria; fever 7 days.
13	P. D.	31/7/24	8/12/24	130	+	Icterus; albuminuria.
14	S. M.	12/8/24	2/12/24	112	+	Fever 8 days; oliguria; albuminuria; bradycardia; epistaxis; bleeding from gums
15	K.	18/8/24	23/12/24	127	+	Diagnosed by Dr. Hanson as a "mild case of yellow fever."
16	S. M.	20/8/24	12/12/24	114	+	No history available; diagnosed as "yellow fever."
17	E. A.	25/8/24	24/1/25	152	−	Icterus; oliguria; albuminuria and cylindruria; vomitus spotted with blood; bleeding from gums; menorrhagia.
18	V. G.	28/8/24	2/12/24	96	+	Melæna, icterus; epistaxis; oliguria; albuminuria and cylindruria.
19	J. A. M.	31/8/24	2/12/24	93	+	No history available; diagnosed yellow fever.
20	S.	31/8/24	15/12/24	106	+	Mild case (Dr. Hanson), fever 5 days.
21	A. F.	?/8/24	8/12/24	130?	+	Mild case (Dr. Parada).
22	R. R.	?/8/24	31/12/24	150?	+	No history available, but his physician called it a typical case.
23	C.	4/9/24	15/12/24	102	+	Diagnosed mild case (Dr. Hanson); rapid recovery.
24	S.	4/9/24	26/11/24	82	−	Regarded by Dr. Hanson as atypical and questionable; given anti-icteroides serum on first day; improvement in few hours.
25	A. E.	8/9/24	2/12/24	115	+	Mild case, characterized chiefly by albuminuria; oliguria; cylindruria and bradycardia.
26	J. B.	?	8/12/24	?	+	No history available.

TABLE B.—PFEIFFER TESTS WITH SERA OF SUSPICIOUS YELLOW FEVER CONVALESCENTS FROM AHUACHAPAN AND CHALCHUAPA (SALVADOR), 1924.

Case number	Name	Date of onset	Date of Pfeiffer test	Number of days between illness and test	Result of Pfeiffer	Remarks
27	R. L.	2/9/24	22/12/24	111	−	Suspicious case in Ahuachapan; but no vomiting; no jaundice and no congestion of eyes, according to patient.
28	F. C.	3/10/24	22/12/24	80	+	Suspicious case in Ahuachapan.
29	G. A.	13/10/24	22/12/24	70	+	Suspicious, mild case in Ahuachapan.
30	M. G.	7/9/24	23/12/24	107	−	Suspicious case in Chalchuapa; *Plasmodium vivax* and *falciparum* found in blood during illness.
31	C. F.	1/10/24	23/12/24	83	−	Suspicious case in Chalchuapa.

occur during epidemics. With the hope that these cases might also be detected by the Pfeiffer reaction, sera were obtained from twenty-two children from 6 to 9 years of age (Table D), who had lived in San Salvador during the epidemic of 1924. All the sera gave absolutely negative results, hence no evidence was obtained in favour of the assumption just mentioned.

Pfeiffer tests were made also on another group of sixteen men (Table E), most of them young adults, natives of Salvador, employed as inspectors for the Anti-Larval Campaign in Salvador. With one exception all the results were negative, and the serum which gave a positive result was from a man (Case 76) who had had yellow fever in Peru in 1920 (diagnosis by Dr. Hanson).

In Table F are listed nine individuals who were vaccinated about three to five months previous to the Pfeiffer test. In no instance was there anything in the history suggestive of yellow fever either before or after vaccination. Of these, three sera gave strongly positive, three weakly positive, and three negative Pfeiffer reactions. These results show that in some vaccinated individuals, even after a period

TABLE C.- PFEIFFER TESTS WITH SERA OF NORMAL SOLDIERS FROM BARRACKS WHERE YELLOW FEVER CASES OCCURRED IN 1924.

Case number	Name	Result of Pfeiffer	Remarks	Vaccinated against yellow fever
32	A. R. F.	–	Born in Mejicanos (suburb of S.S.); two years in S.S.; in barracks since March, 1924	No.
33	E. M.	–	Born in Mejicanos (suburb of S.S.); six years in S.S.: in barracks since April, 1924	No.
34	B. A.	–	Born in San Pedro Perulapán; five years in S.S.; in barracks since March, 1924	No.
35	C. S.	± weak	Born in Santo Tomás; two years in S.S.	Yes, about 150 days previously.
36	R. C.	–	Born in San Marcos; two years in S.S.	Yes, about 150 days previously.
37	C. G.	–	Born in Chinameca (Dept. San Miguel)	No.
38	C. C.	–	Born in Santa Tecla (suburb of S. S.); seven years in S. S.	No.
39	P. M.	-	Born in San Pedro Perulapán; two years in S.S.	Yes. 130 days previously.
40	P. P. B.	–	Born in San Pedro Masahuat; five years in S.S.	No.
41	A. A.	–	Born in San Miguel; eleven months in S.S.	No.
42	P. E.	–	Born in Tonacatapeque; nine months in S.S.	No.
43	S. J.	–	Born in Jocoro (Dept. Morazán); three years in S.S.	Yes. about 160 days previously.
44	V. LeL.	–	Born in Santiago Texacuango (Dept. S.S.); two years in S.S.; in barracks since Oct., 1923	No.
45	C. S.	–	Born in San Isidro (Dept. S.S.); two years in S.S.; in barracks since Oct., 1923	No.
46	T. N.	–	Born in San Antonio Abad (Dept. S.S.); one year in S.S.	No.

S.S. = San Salvador.

TABLE D.—PFEIFFER TESTS WITH SERA OF CHILDREN.

Case number	Name	Age	Result of Pfeiffer	Remarks
47	L. T.	8	–	Born in S.S. and has always lived there.
48	A. M.	8	–	Born in San Miguel; in S.S. since Jan., 1924.
49	C. A. R.	8	–	Born in S.S. and has always lived there.
50	J. C.	8	–	,, ,, ,,
51	J. O.	8	–	,, ,, ,,
52	E. E.	8	–	Born in Huizucar, but lives now in S.S.
53	L. G.	8	–	Born in S.S. and has always lived there.
54	J. E.	8	–	,, ,, ,,
55	J. C. R.	8	–	,, ,, ,,
56	F. Q.	8	–	,, ,, ,,
57	A. V.	8	–	,, ,, ,,
58	V. C.	8	–	,, ,, ,,
59	E. M.	8	–	,, ,, ,,
60	A. V.	8	–	,, ,, ,,
61	H. S.	7	–	,, ,, ,,
62	V. F.	8	–	,, ,, ,,
63	A. H.	9	–	,, ,, ,,
64	A. M.	8	–	Born in Tomanque; in S.S. five years.
65	R. V.	9	–	Born in S.S. and has always lived there.
66	G. M.	8	–	Born in S.S. and lived in suburb of S.S. five years.
67	O R.	9	–	Born in San Miguel and now lives in S.S.
68	F. S.	6	–	Born in S.S. and has always lived there.

S.S. = San Salvador.

of five months, the serum still has lytic action on *L. icteroides*. The number tested is not large enough to permit more definite conclusions as to the duration of immunity after vaccination.

TABLE E.—PFEIFFER TESTS WITH SERA OF SANITARY INSPECTORS.

Case number	Name	Result of Pfeiffer
69	C.	−
70	A.	−
71	S. M.	−
72	E. G.	−
73	C.	−
74	Q.	−
75	B.	−
76	S.*	+
77	J. V. M.	−
78	M.	−
79	G.	−
80	M.	−
81	V.	−
82	L.	−
83	L. C.	−
84	C.	−

* Had yellow fever in Peru, 1920. Diagnosed by Dr. Hanson.

there was no serum left with which to repeat the test. In Case 87, however, we obtained the following information from the individual himself:—

Aged 24. In May, 1924, he was taken sick with severe backache, headache, and fever lasting four days. His eyes were congested, but he recalls no vomiting, nor any black or bloody stools. At the end of the attack he thinks he was jaundiced. He was not seen by a doctor. He further stated that an aunt living in the same house had a similar attack at least half a month before he was taken sick.

This history might be interpreted as that of a mild, atypical case of yellow fever, having occurred in San Salvador about one month before the first case that was definitely recognized as yellow fever. In both this case as well as in Case 91 the positive reaction of the serum may have been the result of a yellow-fever infection in either this or in a previous epidemic. With the exception of these two cases we were able to get evidence by means of the Pfeiffer reaction that yellow fever occurs in such a mild form that it is clinically not recognized.

TABLE F.—PFEIFFER TESTS WITH SERA FROM VACCINATED, NORMAL INDIVIDUALS.

Case number	Name	Number of days between vaccination and test	Result of Pfeiffer test	Remarks
35	C. S.	about 150	+ (weak)	Exact date of vaccination not available.
36	R. C.	about 150	−	,, ,, ,,
39	P. M.	about 130	−	,, ,, ,,
43	S. J.	about 160	−	,, ,, ,,
92	A. S.	152	+ (weak)	Vaccinated, 2 injections, July 22 and 27, 1924.
93	L. S.	152	+ (weak)	,, ,, ,,
94	A. C. G.	153	+	,, ,, ,,
95	C. M.	153	+	,, ,, ,,
96	M. E. C.	91	+	Vaccinated, 1 injection Nov., 1918; 2 injections Feb. 1919; 2 injections Oct., 1924.

TABLE G.—PFEIFFER TESTS WITH SERA FROM A GROUP OF NON-VACCINATED, SUPPOSEDLY NORMAL INDIVIDUALS.

Case number	Name	Result of test	Remarks
85	La C.	−	Had malaria when blood was taken for test.
86	S. E.	−	Had yellow fever in Santa Elena, Salvador, 1900.
87	J. M.	+	History suspicious of yellow fever in May, 1924, obtained from individual after the test.
88	M.	−	Born in U.S.A. Has been in Peru several years.
89	J. O.	−	Infant, aged 17 months. No history.
90	C. Q.	−	Malaria in August, 1924.
91	I. G.	+	Born in Chalatenango, Salvador. No history of illness.

Among the cases listed in Table G is that of a woman (Case 86) who had yellow fever during an epidemic in Santa Elena, Salvador, in 1900. After an interval of twenty-four years, her serum gave a negative Pfeiffer test. The serum from Case 76 (Table E) still gave a positive reaction after a lapse of four years. That the duration of the property producing the Pfeiffer phenomenon is variable in different individuals is known, and there are two instances recorded [4] where positive reactions were obtained after four and four and a half years respectively.

Cases 85 to 91 inclusive (in Table G) were individuals of whose past history nothing was known before the test. They were negative with the exception of Cases 87 and 91 which gave positive Pfeiffer reactions. Case 91 could not be located after the test, hence the history could not be obtained, and

(II).—PATHOLOGY OF YELLOW FEVER IN SAN SALVADOR, 1924.

In view of the fact that autopsy material fro recent cases of yellow fever appears destined become increasingly more difficult to obtain, it seem justifiable to present here, in abstract form, histori and autopsy protocols in addition to the descriptio of the histopathology of the newly acquired materi even though the latter is rather scant.

Case 1.—O. F. C. H., aged 29, merchant, Germa Onset June 7, 1924. Temperature (buccal) 40° C., mark cephalalgia, rachialgia, discomfort in epigastrium, agitatio bilious vomiting; urine dark, without albumin. June 8: A. temperature 39° C., symptoms more pronounced. June temperature 37·5° C. "Black vomitus" severe. Jaundi which had appeared after the first twenty-four hours, st present. Almost complete anuria. Delirium in the night. Sto black (melæna). Malaria parasites absent. June 10: Comple anuria (*see* autopsy); black vomitus abundant; convulsio fever dropping, pulse almost imperceptible. Coma, death.

Autopsy.—Performed one hour after death by Dr. Zuniga Idiáquez. Skin and scleræ pronouncedly icteric. *Stomach:* Contains large quantity of "coffee-ground" liquid. The mucosa has hæmorrhagic spots, and numerous small erosions. *Small intestine:* Contains black material, and both small and large intestine are congested. Some mesenteric lymph nodes are enlarged. *Liver:* Normal in size, yellow (like straw) and friable. *Gall-bladder:* Contains normal bile, but no calculi. *Spleen:* Slightly enlarged, passive congestion. *Kidneys:* Turgid, increased in size, with parts stained yellow. Capsule not adherent. *Bladder:* Contains 30 c.c. markedly albuminous urine. *Pancreas and adrenals:* Normal. *Lungs:* Calcified node in apex of left lung and calcified nodes in hilum of same side. *Heart:* Firm, normal size.

Histological examination (hæmatoxylin and eosin sections).—The material received by us from this case consisted of pieces of liver and kidney embedded in paraffin. Since no other tissue was available, stains for fat could not be made. *Liver:* Necrosis of cells extends nearly throughout the entire lobule; only small groups of intact cells are on the periphery of lobules and around central veins. The necrotic material is coarsely granular and stains deep red. The other cells, as well as those only slightly necrotic, are vacuolated. A moderate degree of round-cell infiltration exists in the parenchyma and a lymphocytic infiltration in the periportal connective tissue. Mitotic figures were not found, but some nuclei of liver-cells are hyperchromatic and increased in size.

Kidney.—There is no necrosis but there are many hyalin- and blood-casts in the tubules. There is a large amount of granular material in the lumen. A number of small hæmorrhages are present. In the capsule of the glomeruli there is an exudate of serum.

Case 2.—J. R. A., aged 17, musician, born in Guadalupe, Department of San Vicente. Became ill on July 13, 1924, and died July 20, in the hospital.

Case 2 was diagnosed as yellow fever, but no history could be obtained. However, an autopsy protocol and pieces of liver and kidney embedded in paraffin were received.

Autopsy.—Autopsy performed by Dr. Lardé, fourteen hours after death. Skin and scleræ markedly icteric. Peritoneum yellow. *Stomach:* Dilated and contains liquid of a dark colour. Mucosa, markedly congested, has ecchymoses and small erosions. These lesions more marked near the cardiac end. *Small intestine:* Contains liquid of same colour as the stomach, and the first portion of the duodenum has lesions similar to those in the stomach. *Spleen:* Weight 210 grm. Firm in consistence and normal in colour. *Adrenals and Pancreas:* Normal. *Liver:* Weight 1,602 grm. Yellowish in colour. *Gall-bladder:* Contains 15 c.c. bile, no stones. *Kidneys:* The right weighs 164 grm. and the left 167 grm. Signs of nephritis. *Urinary bladder:* Contains 150 c.c. albuminous urine. *Pericardial sac:* Contains 30 c.c. yellow liquid. *Heart:* Weighs 415 grm. *Lungs:* Congested.

Histological examination (Hæmatoxylin and eosin sections).—*Liver:* Necrosis of the intermediary zone is very extensive, and only very narrow rings of intact cells exist around the central veins and periphery of lobules. Vacuolization (probably fat) is marked in the preserved cells and those undergoing necrosis in the intermediary zone, but it is much less marked in the cells and the periphery of the lobules and around the central vein. Mitotic figures are numerous among the preserved liver-cells. The necrotic masses of cells stain deep red. An infiltration of round-cells with some polynuclears exists throughout the liver. In the connective tissue around the portal canals is an infiltration of lymphocytes.

Kidney.—The nuclei of the tubules are small and pyknotic, and mitoses are present. Cell outlines are not visible and many nuclei are absent, indicating necrosis. The tubules contain hyalin- and red-cell casts. Small areas of hæmorrhage are present. There are some lumina that contain large globules, approximately the size of epithelial cells. These globules are either discrete or conglomerate (some mulberry-shaped) and they stain various shades of blue, generally very dark blue suggesting calcification. Some are stratified and have concentric rings, and sometimes these blue bodies exist as large granules (figs. 1 and 2).

Case 3.—R. M., aged 21, mechanic, German. Became sick on July 14 and died on July 20. No clinical history is available, but an autopsy protocol and pieces of tissue from liver and kidney fixed in Bouin's picroformal and embedded in paraffin were received.

Autopsy.—Performed by Dr. Lardé fourteen hours after death. Marked icterus of skin and scleræ. Peritoneum shiny and yellow. *Stomach:* Dilated, contains a black liquid. Mucosa is the site of some ecchymoses and numerous small erosions. *Small intestine:* Contains black liquid. Duodenum has ecchymoses and erosions. *Large intestine:* Black fæcal contents. *Spleen:* Weighs 300 grm. Dark red. *Liver:* Weighs 1,110 grm. Yellowish. *Gall-bladder:* Contains 15 c.c. bile, but no stones. *Kidneys:* The right weighs 162 grm. and the left 154 grm. Colour is dark red. *Adrenals and pancreas:* Normal. *Urinary bladder:* Contains 200 c.c. albuminous urine. *Pericardial sac:* Contains 30 c.c. yellow liquid. Some small ecchymoses in the parietal serosa. *Heart:* Weighs 450 grm. *Lungs:* Congested and œdematous.

Histological examination (Hæmatoxylin and eosin sections).—*Liver:* Extensive necrosis and vacuolization of almost the entire lobule. Among the necrotic cells are some cells with preserved nuclei and especially on the periphery of the lobules are these cells more numerous. Vacuolization is very marked. There exists a moderate infiltration of round-cells and polynuclears throughout the lobule, and there is a lymphocytic infiltration of the periportal tissue. Lobules and trabeculæ are not readily made out. Only small foci of less extensively damaged cells are located on the periphery of lobules and around central veins. A few mitoses are present.

Kidney.—Cloudy swelling of the epithelium of the convoluted tubles exists, and there are nuclei in various stages of karyolysis and karyorrhexis.

Case 4.—V. S., aged 27, born in San Salvador. Became sick on August 10 with fever, headache, and backache. Vomitus at first bloody, but later became black. Seen by physician for first time August 13. On that day had temperature 38° C., pulse weak, bleeding gums, bloody stools, epistaxis, generalized jaundice, greenish-yellow papules on lower extremities and on back. Urine scanty. Arrived in hospital August 15, delirious and dyspnœic. Face pale, lips cyanotic; conjunctivæ injected; scleræ reddish-yellow with some spots of extravasated blood; gums bleeding; extremities cold; stools bloody; no urine obtainable on catheterization; temperature 37·5° C., pulse 52; died at 9 a.m.

Autopsy (time and operator not stated).—Generalized jaundice; ecchymotic spots on cornea (?) of right eye, ecchymotic spots on gums, marked on inferior maxilla; a thin layer of coagulated blood on the labia majora. Peritoneum, strongly icteric; no excess liquid. *Liver:* Weighs 1,260 grm. Consistency is soft, somewhat friable and has externally an orange colour, with red ecchymoses. On the cut surface lobules cannot be distinguished, and the surface is smooth, yellow, and dotted with hæmorrhages. Gall-bladder and bile-passages are normal. *Stomach:* External surface yellow and hyperæmic. Contains 200 c.c. black liquid with bloody detritus in suspension. Many punctate hæmorrhages in the mucosa. *Duodenum:* Contains black material, similar to that in stomach. *Small intestine:* Contains dark, lead-coloured pasty material. The mucosa presents hæmorrhagic suffusions and the serosa numerous ecchymoses. *Large intestine:* Contains melanotic fæcal material. *Spleen:* Weighs 189 grm., and presents a normal appearance. *Kidneys:* The right weighs 147 grm. and the left 152 grm. Consistency is soft and the external surface is red. The cut surface of cortex is studded with punctate hæmorrhages. The medulla is red-wine colour. *Urinary bladder:* Distended with urinous ochre-coloured liquid. The mucosa is hyperæmic. *Adrenals and pancreas:* Normal. *Uterus:* The cervix is ecchymotic and the uterine cavity contains yellow mucus. The tubes are notably congested. *Pleura:* Ecchymotic spots on the visceral layer. *Lungs:* Congested and œdematous. *Heart:* Weighs 295 grm. Myocardium is flaccid and there is hypertrophy of left ventricle. Tricuspid and mitral valves have marginal endocarditic lesions.

Histological examination.—The material obtained (liver, kidney, heart, and spleen) were in formalin. *Liver:* In the hæmatoxylin and eosin sections the lobules can be made out, but the cords are distinguishable with some difficulty. Liver-cells are preserved only in small groups on the periphery of lobules and around the central vein. The cells between contain numerous fine vacuoles, but actually necrotic cells with lost nuclei are scarce and only occur scattered individually or in minute groups. The cytoplasm stains deep-red with eosin. The cells are swollen and the sinuses nearly obliterated. Among the liver-cells are lymphocytes and polynuclears. Red cells seem to be absent. The fibrous tissue is increased around

the portal canals but does not extend completely around the lobules. This connective tissue is markedly infiltrated, chiefly with lymphocytes, but also with a few large mononuclears.

In the scarlet R. sections the liver cords appear to be better preserved. Fatty degeneration is uniformly distributed throughout all the cells of the lobules. The fat is abundant and exists

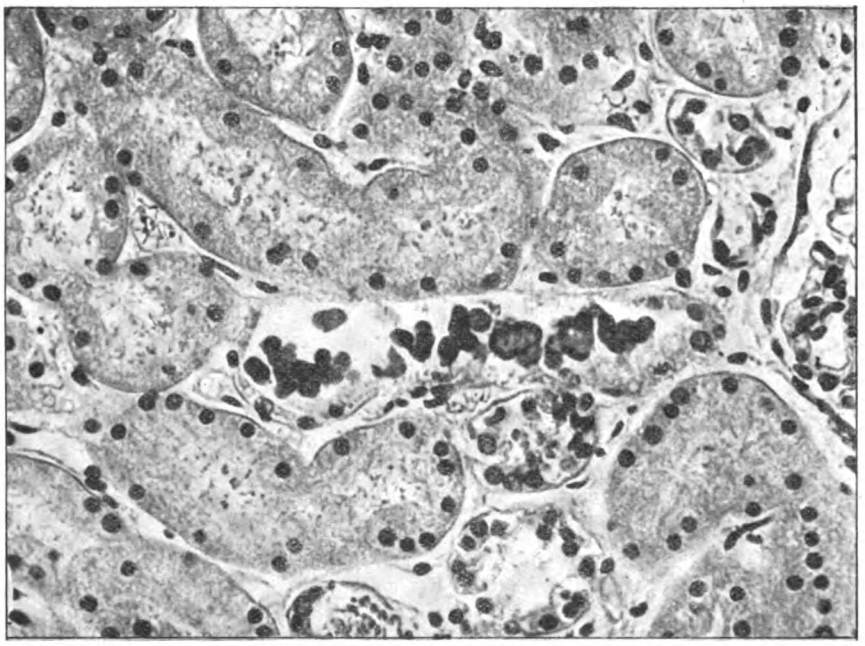


FIG. 1.

Case 2.—"Lime-casts" in Kidney. Calcified globules resembling calcified desquamated epithelial cells in tubule. Magnification × 370. H. and E. stain.

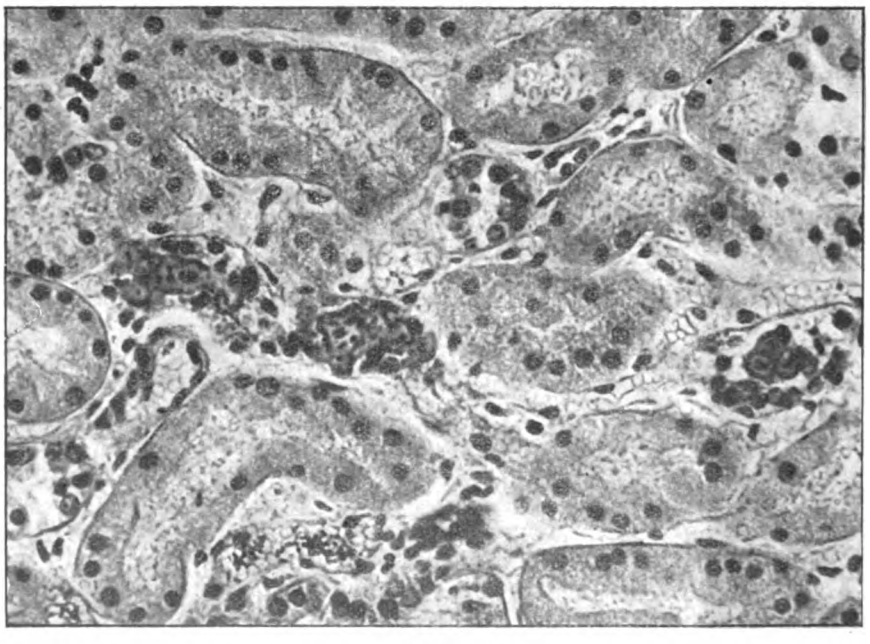


FIG. 2.

Case 2.—"Lime-casts" in Kidney. Calcified globules tending to be fused and forming solid masses. Magnification × 370. H. and E. stain.

Many cells contain very finely granular yellow pigment (bile ?). As a rule the nuclei are well preserved, but some are small and pyknotic. Mitotic figures are not found.

in the form of minute droplets. The epithelial cells of the bile-ducts also contain a moderate number of very fine fat droplets around the nucleus of each cell.

Kidney.—In the hæmatoxylin and eosin sections the cells of the convoluted cells are flattened and very granular. The lumen of the tubules is wide and contains abundant loose granular material. The nuclei are generally small and deeply stained, but in many tubes the nuclei are faint or absent. Some tubules contain red blood-cell casts. Many cells of convoluted and collecting tubules contain fine round vacuoles. The capsule of the glomeruli is slightly thickened and there is a mild infiltration of polynuclear and round cells in the glomeruli. The so-called "lime-casts" are not encountered.

In the scarlet R. sections a fairly marked fatty degeneration of the convoluted and collecting tubules exists, the fat being in the form of minute drops.

Heart.—There is fragmentation of the muscle fibres. Small patches of fibres present, fatty degeneration in the scarlet R. sections.

Spleen.—Follicles are small and sinuses somewhat dilated.

Sections of all these tissues impregnated with silver according to the Levaditi method failed to show any leptospira.

Case 5.—J.E.C., aged 39, born in San Martin, came to the capital two months ago. On August 12 he had prolonged chills and high fever, frontal headache, backache, pain in eyes, pains in muscles, joints and epigastrium. Vomiting was alimentary. Face and conjunctivæ congested. No jaundice or albumin in the urine. August 14: Headache, marked weakness, tiredness. Conjunctivæ slightly congested, scleræ faintly yellow. Vomitus watery and alimentary; stools semi-liquid and yellow. Urine scanty, contained 1·6 grm. albumin per litre. Blood examination showed absence of malaria parasites August 15: Temperature 38·5°C., pulse 100. Urine (250 c.c. passed in twenty-four hours) contains granular and cellular casts. Persistent "bilious" vomiting. August 16: Temperature dropped to 36°C. Anuria. August 18: Frank icteric tinge of scleræ Vomitus is "watery." Urine 30 c.c. passed in twenty-four hours. Temperature 36°C., pulse 80. Blood examination: Red blood-cells = 6,000,260; white blood-cells = 7,000; hæmoglobin 95 per cent.; polymorphonuclears 69 per cent; lymphocytes 25 per cent.; large mononuclears 0 per cent; medium mononuclears 2 per cent; eosinophils 3 per cent; transitionals 1 per cent. August 21: Restless, face slightly congested. Temperature 36°C., pulse 104. Urine 100 c.c. in twenty-four hours. August 22: Shows great anxiety; dyspnœic. Vomitus is watery with some spots of blood Urine 15 c.c. in twenty-four hours. Temperature 36·6°C., pulse filiform, impossible to count. Skin and scleræ jaundiced. Convulsions, death.

Autopsy (time of autopsy and by whom performed not ascertainable).—Jaundice of skin most pronounced on face and front of chest. Peritoneum yellow; no excess amount of liquid. Mesenteric lymph nodes not enlarged. *Stomach:* Dilated and filled with liquid. External surface is orange-coloured, with zones of hyperæmia, and some ecchymoses and blood suffusions. Abundant adherent mucus. *Small intestine:* Contains yellow, semi liquid material. Few spots of bloody suffusions in mucosa. *Liver:* Weighs 1,500 grm. and is of normal size. Colour pale yellow, many ecchymoses. Consistency pasty. The cut surfaces are pale red, studded with many yellow islands. *Gall-bladder* and its ducts are normal. *Spleen:* Weighs 109 grm. Normal in colour, but friable in consistency. *Kidneys:* Right weighs 182 grm. and left 159 grm., notably increased in size. The capsules are adherent. Small hæmorrhages present in cortex. *Urinary bladder:* Contains small amount of urine. *Adrenals and Pancreas:* Normal. *Heart:* Weighs 343 grm. Musculature hypertrophied, flaccid and pale. On the edge of the mitral valve are soft, œdematous nodules. *Lungs:* Bilaterally congested.

Histological examination (pieces of liver, kidney and spleen received in formalin).—*Liver:* The lobules are somewhat less distinctly demarcated than normal, and contain large, fairly well preserved cells around the central vein and on the periphery. The cells between these zones present necrosis and vacuolization corresponding to fat in the scarlet R. sections. This distribution of altered cells, however, is not uniform in all parts of the section, but there may be irregularly scattered patches of necrotic and vacuolated cells, i.e., "focal" necrosis instead of zonal necrosis. In all these zones of necrosis and fatty degeneration the infiltration of cells, consisting of lymphocytes, large mononuclears, and a few polynuclears, is particularly abundant. Around the portal canals there is an increase of connective tissue and a lymphocytic infiltration.

Kidney: There is moderate dilatation of the convoluted tubules which are filled with granular debris. Some tubules without epithelial cell lining contain deeply blue-staining large globules which may be the desquamated epithelial cells. These clumps, lying in the lumen, resemble the so-called "lime-casts." The globules are either conglomerate and form nearly a solid mass or they are more discrete. Necrosis and mitotic figures are absent Fatty degeneration, according to the scarlet R. sections, is relatively slight, being most marked in the collecting tubules. Hæmorrhages are present in both medulla and cortex.

Spleen: The follicles are small No pathological changes to be observed. Levaditi sections of these tissues are negative.

Case 6.—H. R., aged 36, farmer, born in San Vicente, has been in San Salvador for past nine months. October 10, at midnight, had severe chill, followed by fever, nausea and "bilious" vomiting. Had headache, backache and pains over whole body. He was admitted to hospital October 15. Temperature 39° C., pulse 83 (relative bradycardia). Sub-icteric tinge of skin; scleræ reddish yellow. Conjunctivæ very congested. Abdomen tender to palpation; backache marked: hiccoughs. No malaria parasites found in the blood. Urine contains 1·75 grm albumin per litre (Esbach) and many granular casts. October 16: Patient is delirious, and general condition is worse. Temperature 36·5° C., pulse weak, 80 beats per minute. Vomitus is watery with black streaks. 100 c.c. urine passed in eighteen hours. October 17: Temperature 36° C., pulse 82. Delirious; persistent hiccoughs. Scleræ frankly yellow. No vomiting; no stools. In afternoon was catheterized and 30 c.c. urine obtained, which contained 12 grm. albumin per litre (Esbach). October 18: Died at 2 a.m.

Autopsy (time and operator not stated).—Skin, conjunctivæ and scleræ icteric. *Stomach:* Greatly dilated, contains 500 c.c. of black liquid. The smooth mucosa has bloody suffusions and punctate hæmorrhages on the lesser curvature and at cardiac and pyloric orifices. *Liver:* Weighs 1,372 grm Consistency soft and fluctuant, of bright yellow colour and few ecchymoses. On the smooth, yellow, cut surface the lobules cannot be distinguished. *Spleen:* Weighs 140 grm.; appears normal. *Kidneys:* Right weights 120 grm. and left 140 grm. On the cut surface glomeruli appear swollen. Cortex and medulla present small hæmorrhagic spots and streaks. *Heart:* Weighs 304 grm. Consistence is firm and red. *Lungs:* Considerable congestion and œdema, bilateral.

Histological examination (material received in formalin).—*Liver:* Necrosis and vacuolization of cells of almost the entire lobule and only small groups of cells on periphery of lobule and around central vein are spared. Lobules and trabeculæ can be distinguished with difficulty. The vacuoles, which are fine and numerous in each cell, correspond to the fat stained in the scarlet R sections. The groups of necrotic cells correspond in distribution quite closely with the areas of most intense fatty degeneration. The necrotic cells are numerous, and their nuclei are in various stages of degeneration. Polynuclears and mononuclears are found among the necrotic cells. Mitoses are not found.

Kidney: There is marked cloudy swelling with much finely granular material in lumen Necrosis and mitotic figures are absent. Hyalin and blood-casts are numerous. Hæmorrhages, too, are frequent.

Spleen: There is dilatation of the blood filled sinuses. Follicles are small. There is much brown pigment, chiefly in macrophages.

Levaditi sections of liver, kidney, and spleen are negative.

The chief centre of interest in the pathology of yellow fever has, for a long time, been the liver. Chiari [5] has again pointed out recently that the two chief lesions of this organ are fatty degeneration and necrosis. The common feature in all the cases he studied was the existence of necrotic cells in the form of disseminated foci. When these are present in large numbers, the intermediate zone is most affected; the presence of necrotic cells most commonly in the intermediate zone is of secondary importance. Constantly among the necrotic cells can be found cells with marked fatty degeneration. The intermediary zonal necrosis is, however, found in numerous septic

diseases and cannot be regarded as pathognomonic for yellow fever.

With these statements we fully agree, and the aspect of the livers of our six cases confirms Chiari's findings. Case 5, for instance, presents "focal necrosis" as well as a "zonal necrosis."

With regard to the pathology of the kidney it seems that all grades of acute nephritis are found, ranging from severe necrosis of the epithelium of the convoluted tubules to various grades of "cloudy swelling." Hyalin and blood-casts are quite frequently found in the tubules. In two cases (Nos. 2, 5) so-called "lime-casts" are present. Their formation and presence are perhaps dependent on the type of nephritis existing in any individual case. Since in some instances they resemble calcified desquamated epithelial cells (fig. 1) and are present in tubules where epithelium is absent, or where only a few cells still remain in place, it is possible that they are formed only in those cases of yellow fever in which the type of nephritis is "desquamative"; in bichloride poisoning, for example, "lime-cast" formation is frequent. To the "lime-casts," therefore, we cannot assign any pathognomonic significance. It is possible that in certain epidemics of yellow fever the type of nephritis was such as to favour the formation of lime-casts, but in our present series, unfortunately small, they were not constantly present and were found only twice in six cases. Hoffmann [6], on the other hand, found them in twenty-four out of twenty-eight cases.

Fatty degeneration of the kidney is variable in its intensity and in our series was relatively less pronounced than fatty degeneration of the liver. It is most intense and most constantly present in the collecting tubules, but the convoluted tubules are nearly always affected also.

The spleen in our series presents no lesions. This observation is in agreement with the findings of others.

The negative findings in the Levaditi sections were not surprising when it is noted that the material came from cases 4, 5 and 6, in which death occurred five, ten and eight days respectively after the onset of disease, i.e., at a stage when the infectious agent, *L. icteroides*, is known to have disappeared from the body.

SUMMARY.

Among nineteen persons who had recovered from clinically positive cases of yellow fever in San Salvador, in 1924, in sixteen (84 per cent.) the serum gave a positive Pfeiffer test.

Of five persons from the western part of the republic, who had passed through a disease which was clinically suspicious of yellow fever, the sera of two gave positive reactions. The tentative diagnosis of yellow fever in these two cases was thus confirmed by the Pfeiffer tests.

The sera of fifteen soldiers who had lived in San Salvador and in the same barracks where yellow fever had occurred gave negative reactions.

Fifteen normal sanitary inspectors who had no history of yellow fever gave negative Pfeiffer reactions, while the test was positive in the case of one inspector who had had yellow fever in Peru four years previously.

Twenty-two children, from six to eight years of age, who had lived in San Salvador during the epidemic, all gave negative Pfeiffer reactions.

Pfeiffer tests of the sera of vaccinated but otherwise normal individuals showed that in some instances the lytic substances induced by vaccination may still be active against *L. icteroides* after a lapse of five months.

The pathological findings in six cases of yellow fever are presented. In the liver zonal necrosis was present and, more rarely, focal necrosis, together with marked fatty degeneration. Associated with these changes was a round-cell infiltration and a milder polynuclear infiltration. Mitosis and hemorrhages were frequently found. In the kidney there was evidence of acute tubular nephritis of varying intensity. Lime casts were present in two of the six cases. Their appearance suggested that they originated from desquamated epithelial cells which had become calcified. The suggestion is offered that lime casts are formed in some but not all types of nephritis associated with yellow fever, occurring especially when desquamation is a feature.

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OBSERVATIONS ON THE EXPERIMENTAL USE OF FISH INDIGENOUS TO BRITISH GUIANA FOR THE CONTROL OF MOSQUITOES BREEDING IN VATS, TANKS, BARRELS AND OTHER WATER CONTAINERS.

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SINCE my arrival in the Colony, in 1921, I have known of certain water receptacles in which the owners were accustomed to keep one fish or more. In nearly every case the fish was a "hassa" (*Hoplosternum littorale*). In some cases the avowed object was to control mosquito breeding, while in others the intention seems to have been to have early warning in case a malicious neighbour should poison the water supply. In a few cases the belief was held that the presence of the fish ensured purity of the water. A handful of mud is sometimes placed in a barrel as it is thought that the fish thrive better if this is done.

Definite observations were commenced in February 1924, and as initial success was obtained, a large-scale experiment all over the coastlands was begun in August 1924. Every sanitary inspector carried out trials and made reports. Much of this work was not done with any intelligence, and large numbers of reports were

valueless. Laboratory experiments under close observation were then commenced, and also closely observed trials under ordinary conditions at the quarantine station and elsewhere.

The water containers to be dealt with are of innumerable variety. Large specially built vats and tanks are comparatively scarce, and the 40-gallon cask is perhaps the commonest receptacle, while old boiler casings, petrol cans, pans from derelict sugar mills, Dutch stoneware jars and a host of other almost unscreenable makeshifts form the balance.

The mosquitoes to be controlled, and which in this colony choose such receptacles as breeding places, are mainly *Aëdes argenteus* (*Stegomyia fasciata*) and *Culex quinquefasciatus* (*Culex fatigans*), but occasionally along with these *Anopheles tursimaculata* has been taken in an open water vessel.

Some experiments have been made with imported Barbados millions (*Lebistes reticulatus*), but the purpose of the inquiry was to find a suitable indigenous fish which could be easily obtained in quantity and, if possible, a fish well known to all village people, so that they can themselves stock their water vessels.

The following well-known fish have all been given a trial, and some notes are given of the results in every case, but as soon as any fish was found unsuitable for one reason or another its trials were stopped. Full particulars of experiments are only given in the cases of those fish which, as the experiments proceeded, showed a likelihood of being suitable for practical use:—

Local name	Provisional identification
Hassa	*Hoplosternum littorale.*
Patwa	*Cichlasoma bimaculatum.*
Congo Patwa	*Polycentris schomburghi.*
Kakabelly	*Peecilia vivipara.*
Hoorie	*Hoplias malabaricus.*
Sunfish	*Crenicichla saxatilis.*
Silverbait, also called Cellebe	*Tetragonopterus chalceus.* *Charax gibbosus.* *Hemigramms unilineatus.* *Hemigramms rodwayi,* and one not identified.
Millions (a very small fish locally so-called).	*Acanthophacelus melançonus.* *Acanthophacelus reticulatus.*

The small *Acanthophacelus*, locally called millions, are extremely plentiful in many ponds, trenches and concrete gutters, but proved to have no appetite for mosquito larvæ.

Much was hoped for, and expected, from the kakabelly as this fish (*Peecilia vivipara*) has proved of value elsewhere and has been said to possess most of the good qualities of the very effective *Gombusia affinis*. In this colony *Peecilia vivipara* is nearly always found in dirty water, most commonly in the small concrete drains of Georgetown, and the fish has nearly always died soon after transference to clean rain-water.

Never in my experience has this fish come near eating the average of fifty larvæ a day claimed for it in "The Use of Fish for Mosquito Control," published by the International Health Board.

Even had it reached this average it would still be of greatly inferior appetite to some others experimented with.

These experiments were made entirely with larvæ of *Stegomyia* and *Culex*, so it may be that *Peecilia* will redeem its reputation in the experiments with anopheles larvæ now going on.

Congo patwa (*Polycentris schomberghi*). This fish proved to be a hardy and a voracious feeder both in laboratory experiments and under the required conditions, but could not be obtained in sufficient quantity. Details are given of two closely observed barrels containing this fish, as the experiment illustrates a common observation both as regards this fish and the hassa, namely, that sometimes mosquito eggs are not devoured, nor yet larvæ, until these grow to a fair size. No pupæ appeared in the presence of the *Congo patwa*.

Barrels No. 4 and 5 *at Quarantine Station.*

January 3, 1925; Larvæ plentiful in both barrels. One polycentris (about 2½ in.) placed in each barrel.

January 10, 1925: Larvæ present in No. 4. None in No. 5. Fish alive in both.

January 17, 1925: No larvæ in either barrel. Eggs seen in both. Both fish alive.

January 24, 1925: Fine larvæ seen in both barrels. Both fish alive.

January 29, 1925: Eggs and fine larvæ seen in both barrels. Fish alive.

The barrels were regularly observed up to February 25, 1925, and on every occasion eggs and fine larvæ were observed, but never were pupæ or fully-developed larvæ seen. The fish thrived throughout. A control barrel alongside without fish bred mosquitoes to maturity as usual.

The hoorie (*Hoplias malabaricus*) was quite effectively larvivorous, but could not easily be obtained in quantity. This is a fish with a reputation for attacking with great courage and ferocity. It is said to bite the web from ducks' feet; and the white cat familiar to members of the Demerara Golf Club is stated to have had its nose bitten by this fish. I can vouch for the severity of the injuries, but not for the mode of infliction.

The sunfish (*Crenicichla saxatilis*) proved neither satisfactory nor readily obtainable.

The patwa (*Cichlasoma bimaculatum*) is a hardy and voracious feeder, very similar in appearance and habits to its near relation *Cichlasoma cetofasciatum*, the "crana" of British Honduras, which has established itself as a means of mosquito control in that colony. The fish is common, but cannot be obtained in quantity with the same certainty as some others, and does not stand such handling well. It is, however, a very satisfactory controller of mosquito breeding in large containers. The patwa grows to a length of about five inches and a breadth of not much less, and is quite highly esteemed for use as food. In laboratory experiments this fish made a record, one specimen having disposed of as many as 400 larvæ in twenty-four hours. Increasing feeds of larvæ were given each day, beginning with small numbers, and the limit of the fish's appetite was not reached until over 400 larvæ and pupæ were supplied. Like other fish reported on, *Cichlasoma bimaculatum* does not appear to eat mosquito eggs or very small larvæ.

The hassa (*Hoplesternum littorale*) is a tough, hardy fish, varying from about 3 in. to 7 in. in length, very plentiful in roadside trenches, inundated pastures and intentionally flooded canefields, but not

easy to obtain until the dry season sets in, when it is captured in nets and baskets. Unfortunately this fish is much sought after as food, a circumstance likely to limit its applicability to small household water-containers. Like the patwa, this fish seems to feed at night and, whether or no it feeds at the bottom, both in laboratory glass vessels and in tanks and barrels the fish are seen to remain almost motionless at the bottom during daylight.

PRELIMINARY OBSERVATIONS IN MANY DISTRICTS AND IN ALL SORTS OF VESSELS TO DETERMINE GENERALLY THE POWER OF HASSAS TO LIVE UNDER THE REQUIRED CONDITIONS AND CONTROL MOSQUITO BREEDING.

Hassa (*Hoplosternum littorale.*)

Serial number	Kind of vessel	Number of fish	Larvæ	Date of starting experiment	Next observation and remarks
1	Barrel (40 gals.)	1	Many culex and stegomyia	10/7/24	17/7/24. No larvæ.
2	Barrel (40 gals.)	1	,, ,,	4/7/24	7/7/24. No larvæ.
3	Barrel (40 gals.)	1	,, ,,	7/7/24	9/7/24. No larvæ.
4	Barrel (40 gals.)	1	,, ,,	12/7/24	19/7/24. No larvæ.
5	Barrel (40 gals.)	1	,, ,,	30/6/24	25/7/24. No larvæ.
6	Iron pan (100 gals.)	2	Many stegomyia	30/6/24	25/7/24. No larvæ.
7	Barrel (40 gals.)	1	,,	18/7/24	31/7/24. No larvæ.
8	Iron bowl (Tache) 150 gals.	3	Moderate number stegomyia	21/7/24	25/7/24. No larvæ.
9	Tub (20 gals.)	1	Many culex and stegomyia	2/7/24	5/7/24. No larvæ.
10	Barrel (40 gals.)	1	Moderate number stegomyia	17/7/24	20/7/24. No larvæ.
11	Barrel (40 gals.)	1	Many culex and stegomyia	8/7/24	11/7/24. Only very small larvæ present. This condition prevailed for a month. No larvæ pupated.
12	Tank (100 gals.)	1	Moderate number stegomyia	8/7/24	Ditto.
13	Barrel (40 gals.)	1	Moderate number culex	8/7/24	11/7/24. Few larvæ; fish dead.
14	Iron tank (300 gals.)	3	Many culex	5/8/24	16/8/24. No larvæ.
15	Tache (120 gals.)	1	Moderate number culex and stegomyia	10/8/24	15/8/24. No larvæ.
16	Vat (1,000 gals.)	2	Moderate number stegomyia	1/8/24	15/8/24. No larvæ.
17	Vat (2,000 gals.)	4	Moderate number culex	7/8/24	15/8/24. Larvæ reduced but present.
18	Barrel (40 gals.)	1	Few culex and stegomyia	7/8/24	13/8/24. No larvæ.
19	Barrel (40 gals.)	1	Many culex and stegomyia	7/8/24	15/8/24. No larvæ.
20	Barrel (40 gals.)	1	,, ,,	1/9/24	15/9/24. No larvæ.
21	Concrete tank (1,500 gals.)	2	Moderate number stegomyia	9/9/24	23/9/24. No larvæ.
22	Vat (1,000 gals.)	1	Few stegomyia	23/9/24	30/9/24. No larvæ.
23	Tank (80 gals.)	2	Many culex and stegomyia	9/10/24	10/10/24. No decrease. Fish dead.
24	Tank (12 gals.)	1	,, ,,	9/10/24	14/10/24. No larvæ.
25	Tank (80 gals.)	2	,, ,,	9/10/24	16/10/24. No larvæ. One fish dead.
26	Jar (5 gals.)	1	Moderate number culex and stegomyia	9/10/24	16/10/24. No larvæ. Fish stolen, 30/10/24, when no larvæ were found.
27	Barrel (40 gals.)	4	,, ,,	6/10/24	11/10/24. No larvæ. One fish dead.
28	Barrel (40 gals.)	2	Many culex and stegomyia	11/10/24	27/10/24. No larvæ.
29	Barrel (40 gals.)	10	Many culex	10/10/24	14/10/24. No larvæ.
30	Barrel (40 gals.)	1	Moderate number culex and stegomyia	13/10/24	30/10/24. No larvæ.

As illustrating the methods employed at this inquiry, a large number of the observations upon the hassa are given *in extenso*.

CLOSELY OBSERVED EXPERIMENTS IN VESSELS SUCH AS ARE IN COMMON USE, AND WHICH ACTUAL VESSELS ARE KNOWN TO BE FAVOURITE BREEDING PLACES AND WITH A CONTROL VESSEL WITHOUT FISH ALONGSIDE.

Iron tank (400 *gals.*) *No.* 1 *at Quarantine Station.*

October 8, 1924: *Culex* larvæ plentiful. Two hassas placed in tank.

October 14, 1924: All larvæ gone. No pupæ cases or other evidence of hatching. Fish alive.

October 21, 1924: All larvæ gone. No pupæ cases or other evidence of hatching. Fish alive.

Observations continued at intervals never greater than a week up to March 25, 1925, but larvæ were never observed.

The control barrel bred freely all the time.

Iron tank (400 *gals.*) *No.* 2

October 8, 1924: *Culex* larvæ plentiful. Three hassas placed in tank.

October 14, 1924: No larvæ. Three fish alive.

October 21, 1924: No larvæ. Three fish alive.

October 27, 1924: No larvæ. One fish dead and floating. Dead fish removed.

November 3, 1924: No larvæ. Two fish alive.

November 10, 1924: No larvæ. Both fish dead and floating. Dead fish removed.

Larvæ had reappeared in quantity by November 30, 1924.

On many occasions there has been reason to think that, as the hassa is of fair size, he starves once the existing larvæ have been eaten, unless very frequent deposits of eggs are made to keep up the food supply, as indicated by the continued presence of newly-hatched larvæ.

Iron Tank (700 *gals.*) *at County Inspector's House.*

February 5, 1924: *Culex* and *Stegomyia* larvæ plentiful Four hassas placed in tank.

There was steady diminution in the number of larvæ, but a few well-grown ones could be found up to April 25, 1924 when only minute larvæ could be found, none of which reached maturity, but young larvæ were observed throughout August. During August, 1924, one fish disappeared and may well have jumped out. The hassa is given to leaping.

September 8, 1924: No larvæ whatever could be found and all remaining fish were alive

Up to October 30, 1924, no larvæ were found, but during October one fish died and was removed.

On November 21, 1924, another fish was found dead, but no larvæ were found.

At present date, April, 1925, the remaining fish is alive and no larvæ can be found. Throughout the observations on this tank no pupæ were observed.

It seems not unreasonable to suggest that in this case the observed facts accord with the view that while three fish got a good living at first, the rate of deposition of mosquito eggs was insufficient to keep up a food supply for all. No fish died so long as tiny larvæ were to be found, but soon after these disappeared first one died, and then a month later another, while the sole remaining fish apparently continues to get enough to live upon.

Silverbait is a term locally applied to a number of small, bright silvery fish which abound in most clean trenches on the coastlands. Five different fish of this sort have been tried and have been provisionally identified as follows :—

Tetragonopterus chalceus, similar in general habits and appearance to its nearest relative.

Tetragonopterus æneus, which has established its usefulness in anti-mosquito measures in British Honduras. About two inches in average length, this is one of the larger members of the silverbait group.

Charax gibbosus, though never previously used to combat mosquitoes, so far as I can ascertain, belongs to the family of Characidæ, as does *Tetragonopterus*. This also is one of the larger members of the silverbait group. The smaller members of the group are *Hemigrammus rodwayi* and *H. unilineatus*, while the fifth silverbait experimented with has not yet been identified. All five fish were found to be actively larvivorus, attacking larvæ on sight. They live well in water-containers provided they are carefully transported and are transferred to vessels by means of a ladle. They must never be actually handled.

One variety or another, or a mixture of these five fishes may be obtained almost throughout the coastlands, and as they are known to the people generically as silverbait the experiments in actual water-containers were made with mixed lots, such as villagers might obtain for themselves.

Experiments in Actual Water-Containers.

On December 18, 1924, Nos. 1, 2 and 3 iron tanks (each 400 gals.) at the quarantine station were all breeding mosquitoes and are well known to be favourite breeding sites. On that date two "silverbaits" were placed in each, and observations were made every few days up to the end of March, 1925. In each case larvæ and pupæ disappeared in two to three days, and neither eggs, larvæ or pupæ were observed up to the end of the experiment, when all the fish were alive and active.

On January 3, 1925, larvæ were plentiful in barrels Nos 6 and 7 (400 gals.) at the quarantine station, and one "silverbait," about 1½ in. in size, was placed in each. Rapid disappearance of all early stages of mosquitoes followed in each case and this condition was maintained, the fish thriving. On January 29, No. 6 barrel was emptied to within three inches of the bottom to test the capacity of these fish to live in small quantities of shallow water. On February 12 both barrels were free of larvæ and the fish were alive in both, though evaporation had reduced the depth of water in No. 6 to considerably less than three inches. Water was added to a depth of three inches. On February 26 the experiment was closed, the fish still thriving and no signs of mosquito breeding being observed.

Laboratory experiments with silverbait enabled some interesting experiments to be made. All varieties attack larvæ instantly, and when larvæ are scarce in a large vessel the fish pursue them in a determined manner. It has occasionally been observed that on a first transference to a storage vessel the fish sulk for a time before beginning to feed.

All varieties have a preference for pupæ, and if eggs, larvæ and pupæ are given together, pupæ are taken first, then larvæ, and finally the eggs, though any stage if given alone is readily devoured.

A medium-sized *H. rodwayi* was used in a glass jar to determine its maximum destructive power.

On the first day 70 larvæ were given. All were devoured.
On the second day 100 larvæ and 11 pupæ were all taken.
On the third day 29 *Culex* egg rafts were taken in 5 hours.
On the fourth day 150 larvæ and 10 pupæ were all taken.
On the fifth day 200 larvæ and 30 pupæ were all taken.
On the sixth day 250 larvæ and 7 pupæ were all taken.
On the seventh day 260 larvæ and 30 pupæ were disposed of.
On the eight day 300 larvæ and 30 pupæ were given. All pupæ were taken and 260 of the larvæ in 24 hours.

In no experiments with these fish, either in the laboratory or elsewhere, were newly-hatched larvæ ever seen. The fish are practically never still during daylight, and take larvæ equally readily at the surface or the bottom and feed both by day and by night.

An important practical point in favour of these silverbait is that if larvæ are withheld altogether for long periods and no other food provided, they find enough to live on even in a glass jar.

In large vessels the continued presence and activity of the fish can be ascertained by throwing a small stick or a leaf into the water, when the fish are attracted to the surface at once.

Of the fish experimented with those which appear to be most serviceable are the silverbait group, the hassa and the patwa.

For the smaller domestic water-containers it would be difficult to find a fish more generally suitable than the silverbait, whose good points may be summarized as follows :—

(*a*) Enormous appetite for all early mosquito forms.

(*b*) Preference for the forms most nearly hatched out.

(*c*) Ease of obtaining these fish in unlimited quantity.

(*d*) Ability of fish to live when only a minimum of water remains in barrels, &c.

(*e*) Ability of fish to find a living after the original supply of larvæ has been devoured.

A little care is required in the capture and transport of these fish, and a net will often damage them enough to cause early death. A can containing flour or bread crumbs should be lowered by a string into a clean trench and be quickly pulled up after a short interval. The captured fish should then be transferred by ladle into a large vessel. Every transference should be made by ladle.

Hassa and patwa are less suited to the small containers, but do well in large vats and tanks. Among advantages may be enumerated: —

Hassa.	*Patwa.*
(*a*) Good appetite for larvæ.	(*a*) Enormous appetite for larvæ.
(*b*) Fairly easily obtained.	(*b*) Fairly easily obtained.
(*c*) Stands rough handling very well.	(*c*) Survives well in large containers.

Disadvantages are as follows:—

Hassa.	*Patwa.*
(*a*) May be stolen for food.	(*a*) May be stolen for food.
(*b*) May jump out of vessel.	(*b*) Does not stand rough handling well.
(*c*) Does not seem to survive well unless large supply of larvæ is continued.	

Hassa and patwa can be used to advantage in such large vats and tanks as those of Government institutions, when the fish can be caught, handled and regularly observed by members of a trained staff.

Throughout the villages, however, silverbait are proving the most satisfactory, for it is simplicity itself for villagers to be instructed to keep always a few silverbait in the barrel or tank. No offence is caused if these small fish die, and there is no difficulty in replacing them, while there is no temptation to take the fish for food and little, if any, tendency for the fish to jump out or be washed through the overflow in heavy weather. Relief from continual re-screening of vessels is greatly appreciated by villagers.

Since many trenches in British Guiana, although containing numerous fish and apparently clean, are contaminated by sewage, it is well to keep for a period in a pailful of clean water any fish intended to be placed in a source of drinking water.

Mr. Rodway, Curator of the Museum of the Royal Agricultural and Commercial Society, was kind enough to identify the various fish for me, and throughout the inquiry invaluable assistance was rendered by Mr. H. A. Moonsawmy, Member of the Royal Sanitary Institute, Sanitary Inspector for the Port of Georgetown.

Cholera Vaccination; its Effectiveness as evidenced by the Presence of Antibodies in the Blood of Vaccinated Persons (Otto Schobl and Jose Andaya, *Philippine Journal of Science*, March, 1925).—The amount of antibodies found in the blood of cholera-vaccinated persons stands in direct proportion to the amount of vaccine injected and to the number of injections given. Both the titre of the serum and the persistence of antibodies depend on the number of injections to a higher degree than on the amount of the vaccine given.

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AUGUST 1, 1925.

Editorial Notes.

BACILLUS ABORTUS INFECTIONS IN MAN.

IN 1911 Schroeder and Cotton found that Bang's bacillus of infectious abortion was present in the milk of infected cows, and suggested that human beings might become infected.

In 1918 Evans made a thorough investigation of the organism and came to the conclusion that it was very closely related to *Micrococcus melitensis*, the cause of Malta fever in men and goats. He proved that, by inoculating pregnant guinea-pigs with *Bacillus abortus* from bovine sources and with *M. melitensis* from human sources, abortion took place within a few days.

These observations were confirmed by several investigators, and the general opinion, at the present time, is that *B. abortus* and *M. melitensis* are so closely related as to be practically identical. They are identical as regards morphology, appearance of cultures and biochemical characteristics. They cannot be completely separated by agglutination tests. Their effect on animals, except monkeys, is the same. In monkeys *B. abortus* seems to be less virulent than *M. melitensis*. According to most authorities the only means to distinguish the two organisms is Castellani's absorption test. By means of this test not only may *B. abortus* be distinguished from *M. melitensis* but several varieties of each can be separated.

The first authentic case of human infection with the *B. abortus* was reported in January, 1924, by Keefer from Baltimore. The source of infection could not be determined. The fact that the strain was of the abortus type was ascertained by serologic tests. A little later Orpen made known his serologic results with four strains from human cases of Malta fever in South Africa. These agreed with strains of abortus isolated in South Africa, as well as with a strain of abortus from Europe, but not with true melitensis strains from Europe. It was stated by Keefer and Orpen that their cases were clinically typical Malta fever. Later, a case of human infection with the abortus variety of the organism was reported by Evans. The patient, who lived in Virginia, was in the habit of drinking raw cow's milk. Several cases have been reported during the last few years in America, and the Hygienic Laboratory at Washington have been asked to identify three strains of abortus isolated from human cases of Malta fever in South Dakota, Connecticut and New York. In these cases it was impossible for the infection to have come from goats.

It has never been possible to establish definitely the source of abortus infection in man. Suspicion naturally rests on infected cow's milk, but De Korte rightly calls attention to the fact that *B. abortus* is widely distributed in countries where Malta fever-like fevers are absent, and therefore probably is not pathogenic to man through milk.

A cause for abortus infections in man is perhaps the handling of infected animals or carcasses. Cesari points out that in France the majority of cases of so-called Malta fever which cannot be traced to goats have occurred in men employed in slaughterhouses. It is interesting to note that of the few cases of abortus infection recognized in America two of them were in men who handled hog carcasses in slaughterhouses. In a very interesting case reported from South Africa by W. E. De Korte, the patient, a farmer, became infected after handling the placenta of a cow which had aborted the previous day. The observations of Hadley and Beach indicate that infected hog carcasses may be of special danger, and that porcine strains of infectious abortion are more virulent than bovine strains.

VETERINARY EDUCATION IN INDIA.

Fairly up-to-date colleges for the training of students in veterinary science exist at Bombay, Madras, Calcutta and Lahore, and there are also schools at Insein and Taunggyi in Burma. The colleges at Bombay, Madras and Calcutta give a three-year diploma course in English, while that at Lahore gives a four-year course. The number of students passing the final examinations at Lahore dropped from 112 in 1922-23 to 82 in 1923-24. Some of the reasons for this decrease are the inadequacy of the pay of veterinary assistants, the reduction in the number of appointments and the fact that the Military Department no longer sends students to Lahore College.

Instruction in the vernacular is given in the veterinary schools at Insein and Taunggyi in Burma, in a three-year and a one-and-a-half-year course respectively. The final examination at Insein in 1924 was passed by fourteen students as against ten in the preceding year. The Government has partly adopted a scheme for the better equipment of this school.

The first six officers of the Provincial Service selected for a post-graduate course of two years qualifying for appointment to the imperial cadre completed their training at the Muktesar Laboratory during 1923-24. Systematic courses of training in laboratory methods, extending over four or five months, have also been instituted at this laboratory for members of the Indian Veterinary Service and the Royal Army Veterinary Corps, and five officers availed themselves of the facilities afforded during that year.

Seven students passed out during the year from the veterinary compounders' class attached to the Nagpur Hospital.

Good work is done by the United Provinces Veterinary Medical Society, which was founded in 1912. The Society is publishing a veterinary journal in Urdu.

Annotations.

The Sugar Content of the Cerebrospinal Fluid and its Relation to the Blood-sugar (G. M. Goodwin and H. J. Shelley, *Arch. of Internal Medicine*, February 15, 1925).—To be of value in determining whether or not a spinal fluid sugar is high or low, the fluid must be taken after a night's fasting and the sugar content compared to that of the blood taken at the same time. From this paper the following conclusions might be drawn: The sugar content of the cerebrospinal fluid is not constant in the same individual. There is no level, within reasonable limits, which might be considered normal for different individuals. There is a

definite relationship between the sugar content of the cerebrospinal fluid and of the blood, which may be expressed as the percental relation of the sugar content of the cerebrospinal fluid to the sugar content of the blood. This figure lies with fair constancy within the limits of 45 and 65 per cent. The ingestion of carbohydrate in sufficient quantities causes a definite and constant rise in the sugar content of the cerebrospinal fluid and disturbs the usual relationship between the sugar-content of the cerebrospinal fluid and that of the blood. Meningitis, whether tuberculous, staphylococcus or meningococcus, frequently gives a lower sugar content of the cerebrospinal fluid, both as to the actual milligrammes per hundred cubic centimetres and in relation to that of the blood. The literature shows a high sugar content of the cerebrospinal fluid in relation to the sugar content of the blood in cases of encephalitis. Untreated cases of early cerebrospinal syphilis give a low actual and relative sugar content of the cerebrospinal fluid. Under treatment, this figure returns to normal. When considering the fact that the sugar content of the spinal fluid is lowered with a fair degree of constancy in cases of tuberculous, meningococcus and staphylococcus meningitis, one must remember that a low figure after intraspinal administration of antimeningococcus serum is of no diagnostic value.

Notes on the Therapeutic Value of Pneumococcus Antibody Solution Subcutaneously Administered in Lobar Pneumonia (W. W. Oliver and E. A. Stoller, *Arch. of Internal Medicine*, February 15, 1925).—The subcutaneous administration of pneumococcus antibody solution is attended by a very low incidence of thermal reactions as compared with its intravenous use, as reported by Cecil and Larsen, and Conner. The subcutaneous injection of pneumococcus antibody solution invariably produces a painful tissue reaction, and this may persist for days. The subpectoral region seems to be the most favourable site for injection. In this series of twenty-three cases treated by antibody solution only four cases gave evidence of subjective and objective improvement, while the remaining nineteen cases did not appear to be benefited by it. Pneumococcus antibody solution administered subcutaneously did not, in the authors' limited experience, tend to sterilize the blood-stream. Subcutaneous antibody treatment does not appear to prevent extension of the pneumonic process from one lobe to another. The best results were obtained in Type IV pneumococcus, in which the subcutaneous antibody treatment registered a mortality of 21·42 per cent. in the control Type IV cases. If these results were due to antibody solution, it would seem probable that they were attributable to a nonspecific action of the solution.

Action of Acriflavine on the Blood and certain Tissues of Rabbits (F. L. Meleney and Zung-Dau Zau, *Journ. of the Amer. Med. Assoc.*, January 31, 1925).—The bacterial inhibition action of neutral acriflavine within the body is so slight against the hæmolytic streptococcus, even in lethal doses of the dye, that it is not a legitimate intravenous medicament in hæmolytic streptococcus infections. Acriflavine has a selective action on certain body tissues in the rabbit which causes it to be taken up by some of those tissues in such concentration as to injure or destroy them. The kidney and the liver are particularly affected. Chemical substances that are intended for intravenous use in the treatment of disease should be subjected to the most rigid tests on animals to determine their safety as well as their efficiency. The outlines of certain experiments presented by the writers may be used for other chemical substances in connection with hæmolytic streptococci or other organisms.

Latent Syphilis (G. C. Willcocks, *The Medical Journal of Australia*, January 24, 1925).—Routine examination of the blood by the Wassermann test was carried out on 325 consecutive patients. A positive result for syphilis was reported in thirty-one patients. Twenty-six of these gave no history and showed no signs of syphilis. They were suffering from latent syphilis. The symptons and signs observed were not those usually attributed to syphilis. Except in the definitely syphilitic (clinically) patients, no obvious improvement followed antisyphilitic treatment. The cerebrospinal fluid gave a positive result in two out of ten persons. In view of the apparent frequency of latent syphilis it may be that the beneficial effect of potassium iodide in some obscure cases in the past finds here its explanation.

The Possibility of Immunization of the Tissues of the Nose, Throat and Ear by the Use of Vaccines Applied Locally (H. Hays, *Medical Journal and Record*, February 18, 1925).—Reports of the local administration of vaccines for other conditions, such as typhoid fever, have conclusively proved that they will render an immunity. The preparation of the vaccine is extremely simple. The vaccine can be administered without any difficulty directly on the part of the nose, throat or ear which is infected. The broth in which the vaccine grows possibly develops a bacteriophage which augments the effects of the vaccine. Certain definite results have been seen in those infections which do not respond to ordinary antiseptics. The local vaccine can be used on many patients who will not submit to hypodermic injections of vaccines as usually given.

The Question of the Existence of Amyloid Casts (E. R. R. Saleby, *Journal of the American Medical Association*, January 31, 1925).—Histologic sections of amyloid kidneys were stained with methyl violet, and the relative distribution of the amyloid degeneration studied. Casts of various forms were found in forty-five cases; and only one of these, though doubtful whether it was a cast, gave a definite microchemical reaction for amyloid. This would throw doubt on the occurrence of amyloid casts in the urine of patients suffering with amyloid kidney and may show that the specifically staining amyloid plays no part in forming any of the casts.

The Utilization of Solar Light and Heat in the Treatment of Night Soil (M. E. Barnes, *The American Journal of Hygiene*, March, 1925).—Insulated boxes provided with tight-fitting, double layered glass covers, as described by de Saussure, are an effective means of concentrating heat derived from the sun, under conditions prevailing in Siam. The temperatures attained within the de Saussure boxes, under favourable conditions, greatly exceed the thermal death points of the ova and larvæ of hookworms, and the maximum temperatures which have been attained, exceed the thermal death points of all vegetative forms of ordinary bacteria. The utilization of solar light and heat, by means of an adaptation of the de Saussure boxes, in the treatment of night soil in selected regions is suggested (see Abstracts).

Multiple Hæmorrhagic Sarcoma of Kaposi (G. J. Dillard and F. D. Weidman, *Archives of Dermatology and Syphilology*, February, 1925).—This paper is a histological study of two cases, one disclosing intestinal lesions at necropsy. Case 1 was an advanced elephantiasic one with bullæ, which did not come to necropsy. Case 2, in addition to the usual cutaneous lesions, hundreds of small, blood-red tumours were found in the intestines, and a few in the stomach, urinary bladder and mesenteric lymph nodes. Fungous granulomas were found in the sections of the mesenteric and omental nodes within which mycelia and chlamydospores were demonstrable. Histologic studies led to these conclusions: The lesion had its beginnings in the uppermost levels of the corium. The primary change was an irregular hyperplasia of capillaries, speedily accompanied by lymphangiectasia, hæmorrhage and hæmosiderin pigmentation. Secondary changes consisted in an exaggeration of all the processes mentioned above (the angiectases becoming cavernous), to which were added large nodular accumulations of lymphocytes around capillaries, together with nests of embryonal endothelial cells. There was little fibrosis, but much œdema. Kaposi's sarcoma is primarily chronic inflammatory, but secondarily may become sarcomatous. While the sarcomatous changes are not of a highly malignant order, they are definitely within the sarcoma category as viewed in the gastro-intestinal lesions. Authors whose experience has been limited to cutaneous studies are excusable for holding to the chronic inflammatory theory; but this does not constitute the whole disease, and the sarcomatous phase must not be denied. It is an open question whether the fungus invasion by way of the intestines is one of the causes of Kaposi's sarcoma.

It is suggested that in future this disease be regarded in the broadest possible internal medical sense. Patients should be studied from the standpoint of hæmachromatosis of Opie, the question of diabetes mellitus in connection with a pigmentary cirrhosis of the liver should be covered, and in this same connection the newer liver functional tests may prove of value. Examination of the urine for urobilin and hæmatoporphyrin might also give results that fitted into the complex blood destructive processes. In respect to the development of visceral lesions, examination of the fæces and gastric contents for occult blood might give information. The state of the lymph nodes (biopsy), not forgetting the supraclavicular node, should be determined—the presence of the latter may mean the same that Troisier's ganglion does, namely, visceral malignancy. Search for fungus in the fæces and gastric contents is justified, even though the result should be negative in repeated cases, until it is demonstrated that the disease is an ætiological entity, and that fungus causation can be excluded.

Rat-bite Fever with special reference to its Ætiological Agent (M. J. Parmanand, M.B., B.S., *Indian Journal of Medical Research*, April, 1925).—The spirochætes found in the author's Bombay cases of rat-bite fever are morphologically identical with those of the Japanese. Unlike other spirochætes, they are difficult to detect by the dark-ground illumination method. It is more easy to demonstrate them by the staining methods than by the dark-ground illumination. The lesser bandicoot (*N. bengalensis*) is the chief reservoir of infection in Bombay. Spirochætes isolated from naturally infected rats were morphologically indistinguishable from those isolated from human cases of rat-bite fever.

Abstract.

THE UTILIZATION OF SOLAR LIGHT AND HEAT IN THE TREATMENT OF NIGHT SOIL.[1]

By M. E. Barnes, M.D.

THE disposal of the waste products of the human body in such a way as to avoid nuisance and prevent the spread of disease is a problem which confronts every individual in the world, no matter how savage or how refined he may be. It is a problem, moreover, the acuteness of which is increased in direct proportion to the development of man's gregarious tendencies. Isolated individuals may and often do deal with the problem by a process of mental negation, but with communities this is impossible and some positive method of disposal must be adopted. The methods most widely employed throughout the world have been either the removal of such material by water, where this has been possible, or the adoption of some form of disposal upon or beneath the surface of the ground.

The removal of this offensive matter by naturally flowing waters is the easiest method, and consequently, from time immemorial communities have polluted streams. Modern cities have adopted what is simply a more refined method of water pollution in that they pour their wastes into a closed controlled water

[1] Abstracted from the *American Journal of Hygiene*, vol. v, No. 2, March, 1925.

system, and then release such waters into natural channels of flow with or without previous attempts to remedy the pollution. Such refined methods, valuable as they have been demonstrated to be as public health measures, are too complicated and expensive to be universally practicable. For example, only in the larger cities of the Orient could they be installed and successfully operated. For the hundreds of millions of people living in the villages and small cities of the Orient, and, in fact, throughout the greater part of the tropical world, some other system must be found which will be at once efficient, inexpensive, and simple in operation.

The purpose of this paper is to call attention to the possibility of utilizing solar light and heat in the solution of one of the most fundamental problems in sanitation. Whether or not it can be depended upon to accomplish the certain destruction of pathogenic bacteria, this natural force undoubtedly deserves careful consideration as a possible means of freeing night soil of its protozoal and parasitic menace. The possibilities along this line may be better realized when it is pointed out that by the use of an exceedingly simple apparatus, air temperatures of 250° F. have been attained, and large volumes of water have been heated to temperatures of 150° F. (65·6° C.). In one of the writer's experiments the temperature of two litres of water was raised to 160° F. (71·1° C.) and was maintained at a temperature exceeding 140° F. (65·6° C.) for a period of more than four hours. Moreover, the attainment of such temperatures is not limited to days of clear sunlight, the experiments showing the raising of one litre of water to a temperature of 140° F. (60·0° C.) on a day when the sun shone only through a haze, and when heavy clouds passed across the sky.

The possible influence of solar light and heat upon the ova and larvæ of intestinal parasites was first brought to the writer's notice during an anti-hookworm campaign in northern Siam in 1917. The microscope was being used to demonstrate to the villagers the living larvæ of hookworms in the infected soil of their own villages. The material for such demonstrations was secured from scrapings of soil which had recently been polluted with human fæcal matter. It was soon observed, however, that if such fæcal deposits had been exposed to the unobstructed rays of the sun for any length of time, living larvæ were not to be found in such material, or were present in very small numbers. Dead larvæ could be found, evidently having been killed by the sun's light or heat. Occasional references to similar observations may be found in the writings of those engaged in the study of these parasites. Thus, Augustine (1923) states that "a rapid dying out of the larvæ occurred under direct sunlight; out of an original number of 645 larvæ only one survived a week."

Heat is generated from the sun's rays when interference is offered to their passage. Certain substances, such as air, glass, &c., are largely diathermous and offer little resistance to the passage of solar rays. Hence comparatively little heat is generated in such substances. Opaque objects, on the contrary, and especially black objects offer the maximum resistance to their passage, and the greatest amount of heat is generated on the surface of such substances. The heat thus generated is rapidly dissipated by conduction and convection, though substances differ very greatly in their ability to conduct heat. One of the first problems in utilizing the heat generated by the sun's rays is the devising of some means of confining it within certain limits by preventing its rapid dissipation. This can be done by constructing a chamber of the desired size and insulating it by surrounding it with substances of poor conductivity for heat. For experimental purposes sawdust can be used. Glass has the property of offering slight resistance to the passage of solar rays, but of offering relatively great resistance to the passage of heat. Therefore, by using a tight-fitting glass cover upon an insulated chamber, the sun's rays can be admitted to the chamber, there transformed into heat, and the dissipation of the heat delayed to a certain extent. The dissipation of heat from such a chamber can only be delayed, because even though the walls may be well insulated, there is a constant loss occurring by conduction of heat through the glass cover.

According to Ackermann (1915) the principle of using a tight-fitting diathermous cover upon an insulated chamber appears to have been first employed by H. B. de Saussure, who in 1766 invented a "hot box," which consisted of an insulated air-tight wooden box, black inside, and covered with two layers of plain glass with an air space between them. Sir John Herschel in 1837 experimented with a similar apparatus which is described as "a small mahogany box, blackened inside, covered with window glass fitted to size, but without putty, and simply exposed to the sun's rays."

The experiments recorded below were performed by the writer, partly in Chiengmai, Siam (1920) and partly in Bangkok (1922) to determine the temperatures registered by such an apparatus under conditions prevalent in Siam. The de Saussure box, used in the Chiengmai experiments, consisted of a pine wooden box 20 × 14 × 6 inches in length, width and depth respectively, the boards being approximately 1 inch in thickness. A shallow tin vessel, made by splitting a 5-gallon oil tin longitudinally, was placed in this box and a tight-fitting cover of window glass was provided. In the first experiment a control was run, using an identical apparatus except that no glass cover was provided. The tin vessels in both instances were blackened to increase the absorption of solar rays. A cooking thermometer was placed in the covered box, and an ordinary thermometer was used in the open box, both instruments being graduated in the Fahrenheit scale.

(1) The Difference in Temperature Produced in an Enclosed Area by the Interposition of a Tight-Fitting Glass Cover.

The two boxes described above were placed flat upon the ground in such a position as to receive the direct rays of the sun throughout the day, but without any change being made in their position to correspond with changes in the elevation of the sun. The maximum temperature observed within the covered

box was 200° F. (93·3° C.), and for a period of more than six hours the temperature exceeded 126° F. (52·2° C.). The maximum temperature observed in the control box was 124° F. (51·1° C.) which was maintained for only about fifteen minutes.

(2) Temperature with Water within a de Saussure Box, with a Single Glass Cover.

As a means of approximating the actual amount of heat produced in the box, 1 litre of water was introduced into the tin vessel in the de Saussure box, and the temperature of this amount of water observed from time to time. The maximum temperatures to which this amount of water was raised on the four days recorded below were 158°, 150°, 146° and 154° F. respectively (the calculated Centigrade equivalents being 70°, 65·6°, 63·3° and 67·8°). It will be observed also that the litre of water was held at a temperature above 122° F. (50° C.) for periods of from four to five hours on each of these days. These sustained temperatures are quite as important as the maximum temperatures in a consideration of the possible practical applications of the de Saussure principle.

(3) Temperature of Water within a de Saussure Box Provided with a Double Glass Cover.

At this time the sky began to be cloudy and rains threatened. It seemed desirable to attempt to further insulate the apparatus, as the amount of heat absorbed during such weather would be expected to be less than in clear weather. Accordingly, a second layer of glass was fitted to the cover, with an air space between the glass sheets of 1 inch. In spite of the fact that on only one of the days recorded below there was clear sunshine, the temperature of the water reached 140° F. (60° C.) or more on five out of the seven days. Two litres of water were used on the last day, when the highest temperature was recorded.

(4) Effect of Increasing the Depth of the de Saussure Box.

Since only a definite proportion of the solar energy falls on each square foot of the earth's surface, the deepening of the de Saussure box would tend to increase the loss of heat by conduction through its walls. It was of interest to determine, therefore, whether the box could be sufficiently deepened to admit vessels of a large size (e.g., the size of night-soil buckets), without too greatly decreasing its heating capacity. For this purpose a packing box (of 30 × 30 × 36 inches dimensions) was lined with asbestos, and provided with a tight fitting cover with two layers of glass separated by an air space of 1 inch. A small door was made at one side through which the thermometer could be reached. In making the readings there was a small loss of heat involved in the opening and closing of this door. A 5-gallon tin of crude oil was placed in the box, a Fahrenheit thermometer suspended in the oil, and readings were taken from time to time. The maximum temperature to which the 5 gallons of crude oil were raised in the two experiments recorded was 142° F. (61·1° C.). It will be noted that in the second experiment, which ran through the entire day, the oil was maintained at a temperature exceeding 122° F. (50° C.) for a period of over five hours. These experiments were performed in Bangkok, Siam, in 1922.

(5) Effect upon Hookworm Ova and Larvæ of Exposure in a de Saussure Box.

In the apparatus used on August 25, 1920 there were placed ten specimen tins (of ¼-oz. capacity), each containing fæcal matter known to contain hookworm ova and newly-hatched and active larvæ. The covers of the specimen tins were removed, thus bringing the contents into direct sunlight. They were exposed in the de Saussure box from 12 noon to 1 p.m., during which time the thermometer in the box registered 220° F. At 1 o'clock the tins were removed, smears were made and examined, and the contents of each specimen tin placed upon moist soil in small dishes, the soil having been previously heated upon a stove to destroy any larvæ which it might have contained. The larvæ found in the smears made after the exposure were apparently dead. The soil in the dishes was examined daily for a week, but no larvæ were found at any time. Opportunity to continue this line of investigation was lacking.

Discussion.

These experiments have been given in some detail in order to place on record the data they contain concerning the de Saussure box operating under conditions prevailing in Siam. At the same time, they may serve to interest those who may be unfamiliar with the apparatus. Their possible bearing upon the problem of the disposal of night soil is at once obvious when consideration is given to the effects of light and heat upon the various pathogenic organisms found in fæcal matter.

Light has been shown to be injurious to various bacteria. Thus, Buchner found that after exposure to sunlight for one hour, no growth took place in broth cultures of typhoid or colon bacilli or of the spirillum of Asiatic cholera. The effect of light upon protozoan or animal parasites has not been so fully studied.

Jordan (1921) states that "the vegetative forms of most bacteria are killed at 55° to 58° C. by ten minutes' exposure to moist heat." He places the thermal death-point of the typhoid bacillus and of the spirillum of Asiatic cholera at 58° to 60° C., and points out that "the thermal death-point of those bacteria that are at all likely to be present in polluted water is low (57° to 60° C.)." The usefulness of the method of fractional sterilization is dependent upon this vulnerability of vegetative forms of bacteria to temperatures of from 60° to 70° C. (140° to 158° F.).

Boeck (1921) gives the thermal death-points of protozoan cysts as follows, heavy mortality in all cases beginning at temperatures approximately 10 degrees below the maximum:—

E. histolytica	68° C.
E. coli	76° C.
E. nana	64° C.
Iodamœba butschlii	64° C.
Giardia intestinalis	64° C.
Chilomastix mesnili	72° C.

Intestinal helminths are even more vulnerable to heat. Asada (1923) states that *Ascaris* larvæ in the egg-shell are killed if heated for ten minutes at 50° C. Stiles (1921) has indicated the effects of various temperatures upon hookworm ova and larvæ as follows :—

"40° to 50° C. Eggs have been observed to hatch at 40° C., but, in general, constant temperatures above 37° C. are reported as unfavourable to fatal for eggs and larvæ. However, both eggs and larvæ can stand 40° to 50° C. for a few minutes and live.

"50° to 60° C. Fatal to eggs and larvæ in one to five minutes.

"Above 60° C. Fatal to eggs and larvæ almost instantly."

Tsutsui (1924) has shown that 55° C. is the highest temperature to which hookworm ova and larvæ can be exposed and live, and concludes that if fæcal matter could in some way be raised to a temperature of 57° C., all infectivity for hookworm would thereby be destroyed. On account of the coagulation of tissue fluids, which takes place at temperatures around 60° C., it is highly improbable that any of the animal parasites could survive more than momentary exposure to such temperatures.

There appears to be little doubt that, under laboratory conditions, if these various organisms are brought to the actual temperatures indicated, they are killed. The question is whether the constituents of night soil are such as to protect the organisms from actually reaching the fatal temperatures. The only experiment reported in this paper which bears directly upon this point indicates that in small quantities fæcal matter did not protect hookworm ova and larvæ from the fatal effects of heat. The depth of penetration of such heat into fæcal masses exposed in the boxes has not yet been determined. However, as collected in buckets, night soil usually contains a considerable proportion of fluids, and the experiments with the heating of water in the de Saussure boxes give some indication as to what might be expected. If sufficient water were added to permit the circulation of convection currents, fæcal matter exposed in shallow de Saussure boxes could be made to stew for hours on each day of clear sunshine, in tropical countries, in water exceeding 50° C., with maximum temperatures considerably exceeding 60° C. Moreover, this process could be repeated daily for any desired period. The parasitic ova and larvæ or the protozoan cysts which could survive such stewing for even one day would be relatively few, except, perhaps, in the centre of fæcal masses which failed to disintegrate during that time. Such temperatures, together with the sunlight, should make anything but a favourable medium for the vegetative bacteria which were present. The thermophilic reactions of hookworm larvæ should cause any larvæ which might have hatched out to move into the water, as it gradually heated, just as is the case in the Baermann apparatus for the removal of such larvæ from samples of soil. With a properly constructed apparatus, exposure for one day to tropical sunshine should be effective, but a margin of safety might require several days' exposure. Yet even a week's exposure in such an apparatus, if it ensured a night soil that would be immediately and safely available for fertilizing purposes, would offer distinct advantages over the six months' storage which is now estimated as the requisite time to ensure the destruction of the more dangerous elements in such matter.

The practicability of this method of treating night soil is dependent upon its efficiency in destroying the dangerous elements in such material, upon the regularity and intensity of sunshine in the region where its use is desired, and upon the devising of suitable means of exposing the night soil with a minimum amount of handling. These are all matters which can be determined only by extended experiment and observation on the part of those, especially in tropical regions, who have the facilities for making such studies. The method deserves careful investigation in spite of its obvious limitations. Although the interruption in days of sunshine would make it impracticable as the *sole* method of treatment, it may well prove to be a very valuable supplementary method of treatment in communities where the bucket system of collection is in operation. If, instead of burying or of storing such matter for prolonged periods the fæcal matter could be exposed, during favourable weather, in these heated chambers for a time experimentally determined to be adequate to make it innocuous, this would permit its early return to the soil at a time when, presumably, its manurial value would be at the minimum. All night soil thus treated could be made a source of revenue in most tropical countries. During prolonged periods of unfavourable weather the communities could do just what they now do, or they might use fuel for heating on such occasions.

It is hoped that investigators in widely separated regions will undertake experiments with this apparatus to determine the depth of penetration of the heat into night soil, the maximum depth at which the de Saussure boxes will develop effective temperatures (e.g., whether night soil buckets can be treated without emptying), and the length of time of exposure required to ensure the desired result. Even though the destruction of bacteria may not be possible, the rapid destruction of the ova and larvæ or corresponding stages of hookworms and similar parasites, tæniæ, schistosoma, &c., would be of inestimable value in Egypt, India, South China, and throughout the entire tropical and subtropical world.

The apparatus required for such experiments is very simple, consisting, as it does, of an insulated box, lined with sheet iron or other metal, and provided with a tight-fitting double glass cover. For practical use the enlargement of the boxes to a suitable size would be required, thus forming a series of shallow, metal-lined, insulated vats, provided with tight-fitting windows, much like the well-known hot beds so commonly used by gardeners in northern climates during late winter.

If it should prove feasible to utilize heat generated in this way to free night soil of its present dangerous elements, sanitarians would have an additional means of attacking the problem of its disposal in small

communities, especially in tropical countries where sunlight is abundant, intense, and inexpensive.

CONCLUSIONS.

(1) Insulated boxes provided with tight-fitting, double-layered glass covers, as described by de Saussure, are an effective means of concentrating heat derived from the sun under conditions prevailing in Siam.

(2) The temperatures attained within the de Saussure boxes, under favourable conditions, greatly exceed the thermal death-points of the ova and larvæ of hookworms, and the maximum temperatures which have been attained exceed the thermal death-points of all vegetative forms of ordinary bacteria.

(3) The utilization of solar light and heat, by means of an adaptation of the de Saussure boxes, in the treatment of night soil in selected regions is suggested.

Current Literature.

BULLETIN DE LA SOCIÉTÉ DE PATHOLOGIE EXOTIQUE, April 8, 1925.

Bacillus flagellatus and Spirochæta omeliansky n.sp. (W. L. Yakimoff).—In 1914 Professor W. L. Omeliansky found a new organism in a receptacle containing river water. Numerous colonies were isolated on petri dishes, some not stained, others stained in different shades of red. On stained smears a bacillus was seen, with a long flagella at one end, well stained, which was six times as long as the body of the bacillus. This organism was named *B. flagellatus*. The same bacillus has been isolated from water at Chicago by Mabel Jones. During researches on water protozoa at Petrograd this microbe has also been isolated by the author in association with spirochætes; it has also been isolated from the intestine of the frog *Rana temporaria* at Petrograd. The spirochætes which are found with the bacillus have not hitherto been found in water; they are more numerous than *B. flagellatus* and have been named *Spirochæta omeliansky* n.sp.

On the Subject of Vincent's Angina (W. L. Yakimoff, A. Ioukowsky and S. L. Schirwind).—Of the 55 cases of Vincent's angina observed in 1922-23 at the dispensary of the Nicolas Railway, Petrograd, there were 38 cases of the ulcerous type and 14 diphtheroid; and there was one case in which the examination of the suppurations of the ear revealed the presence of fusiform bacilli and Vincent's spirochætes. Thirty-three of the patients were men and 22 women (4 children). The cases occurred in every month of the year, the highest numbers being during July, August, September. All cases were completely cured by treatment with chloride of potassium and perhydrol.

The Protozoa of the Human Intestine. The Examination of the Intestine of Frogs of Petrograd (W. L. Yakimoff and G. A. Miller).—These investigations have been carried out for the purpose of studying the source of human infection by *Chilomastix mesnili*. This organism is frequently found at Petrograd, and ranks as third on the list of the intestinal protozoa of man. The examination of the intestines of thirty frogs (*Rana temporaria*) revealed several species of protozoa, but no *Chilomastix*. A description is given of three spirochætes isolated: *S. ranarum*, n.sp., *S. amphibæ*, n.sp. *S. temporariæ*, n.sp. Species of spirilla were also found. It has not yet been determined whether the spirilla and spirochætes of the frog are in any way connected with the intestinal organisms of man.

Noguchi's Fixator for Spirochætes used for Flagella. (R. Patay.) — Noguchi has described a method of staining by which *Spirochæta cuniculi* and *S. pallida* can be distinctly stained, not only by Giemsa solution but also with basic stainings such as gentian violet and fuchsin. The author having verified the value of this process for the two spirochætes mentioned, tried it on various flagella with very good results. The fixation can be effected on wet or dry smears (the latter is preferred); minimum duration five minutes. This fixative, besides being simple, quickly destroys the red blood-cells and is therefore of great value in the diagnosis of spirochætosis and trypanosomiasis. It clearly shows the parasite in thick blood-smears.

Oicomonas Granulata in the Intestine of White Mice (W. L. Yakimoff and Mlle. J. Wassilewsky).—This organism was first isolated from human stools in 1906. It was found in three cases of intestinal infection, and in 1919 and 1920, during the epidemics of dysentery and cholera in Petrograd, it was observed four times in association with *Entamœba coli*. The organism found in the intestine of white mice is believed to be the same as that found in man; the only difference being a number of granules less elevated. The parasite is easily cultivated on Frosch-Schardinger gelose.

Treatment of Sleeping Sickness (P. Walraven).—The action of 205 Bayer on human trypanosomiasis has varied greatly according to different experimenters. The author has tried it with atoxyl, emetic and neosalvarsan; the results have been more or less favourable. Antimony with Bayer, with or without arsenic, has the best action on the nervous symptoms in human trypanosomiasis.

Epidemiologic and Prophylactic Study of Malaria in Albania (R. Daudy).—The examination of 385 children of Tirana, capital of Albania, showed a splenic index of 28 per cent. and a plasmodic index of 8 per cent. *Plasmodium præcox* is the parasite most frequently found. *P. vivax* is very rare and *P. malariæ* is almost entirely absent. The sites where anopheles are to be found are numerous and cover nearly the whole territory. Preventive quininization does not exist in Tirana. Quinine is used as a curative, but the supplies of quinine to the hospitals and dispensaries are not sufficient. The mosquito net for beds is used in the well-to-do families and in hotels, but there is great need for general preventive quininization and other prophylactic measures in these parts.

The Parasitology and Epidemiology of Malaria in Abkhasie (N. Roukhadze).—Cases of malaria are observed all the year round at Abkhasie. There are three periods, viz., the epidemic period, the winter relapse period, and the spring relapse period. Each of these periods is characterized by the presence in the blood of determined species of parasites; during the winter relapse period *P. malariæ* is found; during the spring relapse period *P. vivax;* and during the epidemic period *P. vivax* and *præcox.*

THE INDIAN MEDICAL GAZETTE.

May, 1925.

Giant Urticaria (Hugh W. Acton).—Giant urticaria or Quincke's œdema is defined by the author as an urticaria produced under the deep fascia by certain bases derived from the food, which only show their effects in those individuals in whom the defence mechanism is low. This defect in the defence mechanism may be inherited or acquired. The disease in India is more common amongst Europeans than natives, but whether this is due to the fact that the cases amongst Indians are misdiagnosed as filarial lymphangitis remains to be further investigated. The disease is probably more common in Europeans owing to the depression of the endocrine functions by long residence in a climate like Calcutta. Both sexes are equally affected; the disease appears in very young children from 15 months to 2½ years and in adults between the ages of 30 to 45 years.

Observations on the Anti-Diabetic Properties of Cephalandra Indica (Telakucha) (R. N. Chopra).—The fresh juice extracted from *Cephalandra indica (telakucha)*, a perennial creeping herb belonging to the natural order Cucurbitacæ, has no sugar-reducing effects when administered to patients suffering from diabetes. The active principles of the plant, an amylolytic enzyme, a hormone, and a body of alkaloidal nature do not produce any reduction of blood-sugar when administered subcutaneously to rabbits.

Observations on the Treatment of Kala-Azar with Urea Stibamine in the Medical Out-Patient Department of the Medical College Hospital, Calcutta (N. C. Kapur).—The results of treatment of fifty cases are given in tabular form. The course of treatment with urea stibamine for bringing about cure in kala-azar is remarkably short. In some of the cases cure took place in only seven days. In cases of antimonyl tartrates the course of treatment frequently extends to more than three months. The average number of injections required for a course of treatment with urea stibamine is about seven to ten, whereas in the case of antimonyl tartrates it frequently amounts to thirty or more. The beneficial effects obtained with urea stibamine in cases resistant to the antimonyl tartrates are strikingly shown in the tables. Jaundice and albuminuria were no contra-indications to the treatment of kala-azar with urea stibamine. Such cases are best treated with small doses, slowly increased. No signs of intolerance were observed in any of the cases. Sometimes a reactionary fever took place after injection which subsided after a few hours. Cases in which signs of intolerance showed themselves after injection of sodium antimonyl tartrate bore urea stibamine very well. The most striking results with urea stibamine are: (*a*) rapid disappearance of the splenic enlargement; (*b*) rapid subsidence of the fever; (*c*) early disappearance of the leukopenia; and (*d*) the short treatment required for a complete cure.

Quinine plus alkalies in the Treatment of Malaria (K. V. Raju).—These observations were made on the in- and out-patients of the M. and S.M. Railway Hospital, Hubli. The conclusions are as follows: As the doses of the two mixtures have to be given according to a strict time-table, the method is more suitable for in-patients than for out-patients. In seventeen cases of proved malaria in the first series treated with the quinine and alkaline treatment alone, the patients became afebrile after 20 gr. of quinine in nine cases; after 40 gr. in two cases, and after 50 gr. in four cases. Crescents were still found in a patient who had taken 100 gr. In nine cases of clinical malaria in the second series, treated with the quinine and alkaline treatment alone, the patients became afebrile after 20 gr. in four instances; after 50 gr. in four instances; and after 60 gr. in one instance. In the majority of cases the mixtures are well tolerated, whilst there is the additional psychological effect of giving two mixtures instead of one to illiterate patients. Although all these patients were instructed to return to the hospital if fever recurred, the only one who did so was the patient who had received an intravenous injection—thirty-three days after the injection. He was now placed on treatment with quinine and alkalies and was discharged well on the tenth day. The combined quinine and alkali treatment is being tried side by side with the ordinary acid quinine sulphate mixture as a control. The scantiness of parasite findings is a feature of the series. If there is any drug which could be administered to drive parasites into the peripheral circulation, it would be of benefit to know of it; arecaline hydrobromide is said to possess this quality, but the author has been unable to procure it from any chemists.

Choroidal Hæmorrhage Following Cataract Extraction (M. M. Cruickshank).—This paper is based on thirty cases of choroidal hæmorrhage occurring throughout a series of 2,777 cases of cataract extraction at Shikarpur, Sind, where the incidence of glaucoma is very high. In the treatment of glaucomatous cataract the importance and the necessity of estimating the tension with the tonometer has been proved; but although tonometry is a valuable guide it is not the only guide as to the operative measures to be followed in the treatment of glaucomatous cataract, and in the prevention of choroidal hæmorrhage.

Original Communications.

BLOOD- AND TISSUE-CHANGES IN CANCER WITH REFERENCE TO DIAGNOSIS AND TREATMENT.

By J. A. Shaw-Mackenzie, M.D.Lond.

Introduction.

My attention was directed early to the examination of certain defensive processes that appeared to be at work in organisms invaded by cancer. The existence of such natural defences may be inferred from the fact that in the human body the disease may remain stationary for a considerable period, or even disappear altogether. The former fact was noted by Sigmond [1] in 1837, whose lectures I quoted from in 1906. The last-mentioned point is well authenticated by occasional cases of unexpected recovery at the present day. Moreover, in inoculated tumour mice, disappearance of the cancerous growth takes place in a large percentage of cases. Last, but not least, a certain number of mice are "negative" to tumour inoculation, a natural immunity that it is not unreasonable to suppose may be present more or less in human beings. On such grounds it seemed to me of the utmost importance that a preliminary investigation should be made of the blood, both in man and in lower animals, in order to ascertain if any differences existed between normal and cancerous blood, and if present, whether these differences could be controlled so as to benefit the invaded organism.

I have now long maintained that certain changes in the blood are present in cancer, in addition to the usual local manifestation. In 1905 [2] I drew attention to cases of cancer in different families in which one or other parent died of diabetes, or diabetes and cancer were observed in members of the same family, and that occasionally the two diseases are coincident in the same subject. Such facts led me to suggest that in cancer there might possibly be some underlying cause in functional defect in the liver or pancreas leading to cell proliferation, and local irritation determine the site of growth. In particular I referred to the ferment erepsin (which is different to trypsin and acts on proteoses and peptones) which Vernon described as universally present normally in all organs and tissues of the body and undoubtedly plays an important part in tissue metabolism. This intracellular enzyme was shown by him and others to be deficient in particular in the liver in certain cases of cancer, and on the other hand to be increased in other cases of cancer as well as in tuberculosis and septicæmia. This led me to suggest that natural and induced increase of the ereptic and proteolytic enzymes in the tissues might be a defensive response.

Lipase; the Lipolytic or Fat-Splitting Enzyme.

Since then my attention has been concerned mainly with another enzyme, namely lipase, the lipolytic or fat-splitting ferment of the pancreas. Changes in the blood in cancer have been found, associated in particular with this enzyme and its defective fat-splitting in the blood and tissues. When small amounts of serum are added to pancreatic extracts or to pancreatic juice itself the fat-splitting action is markedly *increased*. When carcinoma serum or sarcoma serum is added in the same way the action is *decreased*. The central fact in the blood of cancerous subjects is a deficiency of the fat-splitting activity present in normal blood-serum. On the other hand, coupled with improvement or recovery the serum regains its normal power or is increased. This lipolytic increase with corresponding increase in fatty acid products is an important factor in the protective processes of the body. It is particularly the case in malignant disease, although this lipolytic defensive increase or response is not specific to cancer but is common to tuberculosis and other bacterial invasions. It affords, as shown, an explanation in part of induced resistance and of natural and therapeutic immunization. It was found that this increased lipolytic accelerating power of the serum followed injections of certain normal mouse organ tissues known to render such animals immune to subsequent inoculation with mouse tumour. Furthermore, in favour of the view that the action is a protective one is the fact that such increased power of the serum is noticeable in mice which have proved "negative" to mouse tumour inoculation or have recovered spontaneously from large growths. The experiments which led to these conclusions, carried out in the Physiological Laboratory, Bacteriological and Public Health Departments, King's College, have been described in my previous papers [3].

Defective Tissue Lipolysis in Cancer.

The physiological mechanism by which the fats are normally split and utilized in the tissues carried to them by the blood-stream after digestion in the bowel, and the failure of this mechanism in cancer, have been described. Briefly it is that lipase, the fat-splitting enzyme or ferment in pancreatic extracts and in pancreatic juice, is separable into two parts, commonly spoken of as *coenzyme*, and *inactive lipase* or *prolipase*. Each is inactive by itself; but the power of splitting fats is raised to its original value by mixing them together. The inactive lipase is destroyed by heat but the coenzyme is not destroyed. The separation into these two parts in (*a*) extracts was effected by filtering a glycerol pancreatic extract through paper, or when diluted by the centrifuge, or by means of a Pukall clay filter, as shown by Rosenheim [4]; the clear filtrate or supernatant fluid after centrifuging contains the coenzyme, and its activating property has been concluded to be due to organic and inorganic phosphates; the residue of inactive lipase is obtained in the form of a greyish-white deposit; (*b*) I [5] showed a similar separation by heating diluted pancreatic juice; the lipase contained mainly in an inactive form in the juice is thus destroyed, and the thermostable coenzyme remains; but on adding the coenzyme to fresh juice the fat-splitting power is developed. Serum itself, when diluted and heated, as well as a great many organ press juices and tissue extracts, when substituted for the pancreatic coenzyme give similar fat-splitting power or activation,

in different degree. Carcinoma serum, and carcinoma extracts prepared in the same way as extracts of the pancreas, show a similar separation of a thermostable coenzyme which activates inactive lipase, but in less degree compared with normal serum and normal tissue extracts. The finding in this respect seems so similar to the separation of a "specific factor" from virus shown by Dr. W. E. Gye and Mr. J. E. Barnard [6], that I venture to draw attention to this aspect of the matter. In Dr. Gye's researches it would seem that the "specific factor" corresponds to the separable thermostable coenzyme of carcinoma serum and carcinoma extracts. The chemical nature of this substance or coenzyme has not been fully determined. But in carcinoma extracts [7] it has appeared to be in part the nature of a protein and in part a fatty acid digestive product or derivative of lipins (phosphatides) with cholesterol which are soluble in alcohol, ether, and chloroform, with reduced activating properties on lipase. Drew [8] showed that watery extracts of normal organs (kidney, liver, and spleen), and of tumour tissue, when incubated for a short time stimulate cell proliferation of adult tissues very greatly *in vitro* which is more marked in the case of sarcoma tissue. This stimulation seemed to me to be produced by products of partial or defective digestion, whether this is due, as stated in 1913 [9], to imperfect normal enzyme action in the tissues in areas of the body affected or to the presence of unusual enzymes in the cancer material. In this respect it has to be borne in mind that autolysis or self-digestion is synonymous with enzyme action in the cells and tissues; these intracellular and bacterial enzymes may not be identical with those in the alimentary canal, but their action on proteins, carbohydrates and fats and lipins is substantially the same. In this view we have thus a factor or stimulus to cell growth in enzyme action and imperfect products, whether due to prolonged irritation and interference with normal enzyme action, or due to ususual enzymes. In both cases a coenzyme action is concerned, one intrinsic, the other extrinsic, or both. The intrinsic cause underlying the altered metabolism in cancer is not known. But may it not be in addition, as in diabetes that an underlying factor is in faulty action of one or other of the larger organs. In order to make my position clearer I reproduce the following protocol of one of my experiments, referred to already, in 1915, illustrating the inability of either separated coenzyme or inactive lipase alone of pancreatic juice to split fats, but together produce the active normal fat-splitting enzyme; this was estimated, after incubation, by the amount of alkali required to neutralize the fatty acid products liberated, as in the case of similar separation and mixture of the two parts in pancreatic extracts.

Pancreatic juice (fresh)	Pancreatic juice (heated after dilution to 60° C. for 15 minutes)	Water	Olive oil emulsion	Time	N/10 KOH required
c.c.	c.c.	c.c.	c.c.	hours	c.c.
0·5 ..	— ..	2·5 ..	2·5 ..	18 ..	2·0
— ..	0·5 ..	2·0 ..	2·5 ..	18 ..	0·2
0·5 ..	0·5 ..	2·0 ..	2·5 ..	18 ..	10·5

It will be seen that both factors are intrinsic in th juice, but mainly held apart in some unknown way— the inactive lipase or prolipase contained being subse quently activated on the liberation of its natura coenzyme, or by other activators, in the duodenum o by serum. In the same paper it was shown in table that when carcinoma serum alone, or when dilute and heated is substituted for the natural pancreati coenzyme, the result is less than with normal serum The serum from certain specific infectious disease acted similarly, and I have pointed out elsewher that vaccines contain a thermostable coenzyme wit varying activating power. If as demonstrated b Dr. Gye two factors are requisite in tumour produc tion, and that "specific factor" and virus each whe rendered inactive together produce tumour growth, i is difficult to understand this tumour productio *in vivo* without a third responsible factor, namel unusual enzyme action, with consequent productio of abnormal fatty acids, not only in the living an treated virus but in the infected body cell. Dr. Gy himself alludes to a labile chemical substance con tained in the "sand filtrate" rendered innocuou with chloroform, which in some way unknown render the cells susceptible to infection by the virus. On can hardly doubt that the labile substance containe in virus is of a similar nature to inactive lipase, an that it is activated by the "specific factor" in chloro form extracts, in culture filtrates, and in the cell In this connection inactive lipase is insoluble i chloroform. While "specific factor" alone does no produce tumour, as shown by Dr. Gye, the effect o prolonged and continuous action, it would seem, i not excluded. In my experiments it was shown als that graduated additions of carcinoma serum, o serum from infectious disease to the inactive pan creatic fresh juice still further reduce the fat-splittin activation, compared with the progressive rise wit additions of normal serum. In immunization o treatment the treated or killed part or residue i probably an important factor.

Serum Reactions or Blood-Tests in Cance

In 1913 the defective lipolytic action of malignan serum compared at the same time with normal serun led me to utilize this reaction as a means of differen tiation between the two. This method frequentl warranted a positive diagnosis of cancer, confirme later. On the other hand, the absence of the reactio has been of service in excluding cancer in suspecte and post-operative cases. Recovery after operatio was shown by the gradual return of the reaction t normal in favourable cases within nine month These reactions, however, are not specific to cancer, a similar reactions have been found in tuberculosis an other infectious diseases. Later, my investigation have been directed to the serum itself and it behaviour on the addition of different extracts an substances. Serum itself does split fats unde ordinary circumstances.

But addition to normal serum of pancreatic coenzym of lipase after incubation does exert a lipolytic actio As well known normal serum is milky after a mea

When the pancreatic coenzyme is added to and mixed with normal milky serum after a meal, and incubated at 37° C. for two or three hours the serum becomes perfectly clear. It does not do so if incubated without the coenzyme. The addition of the coenzyme to carcinoma cloudy serum does not completely effect clearance. Sodium oleate in weak dilution exerts a similar lipolytic action with normal serum, but in less degree. Turbidity is produced when added to carcinoma serum, but here again similar results were found with tuberculous serum. I prepared therefore alcohol, ether, and chloroform mixed extracts,[1] or ether extract alone of carcinoma tissue, with or without saponification, in the hope that they contain a specific coenzyme or antigen. These extracts in suitable amount, when added respectively to carcinoma serum, after incubation at 37° C. for usually eighteen hours, give a cloud, or turbidity in varying degree, or sometimes a ring at the junction of the fluids with carcinoma serum, visible to the naked eye in good daylight. This turbidity does not appear with normal serum nor with non-cancerous serum with certain exceptions, including tuberculosis, which will be referred to later. In two cases of sarcoma serum the reaction has failed; this has suggested in a possible presence of sarcoma in any given case that sarcoma extracts need to be tried. The saponified mixed extract has an advantage of removing after incubation any slight initial turbidity in control normal serum. I have somewhat discarded the ether extract, owing to the uncertainty of obtaining ether free from alcohol, the presence of which in itself precipitates proteins. More recently I have been using cholin HCl (1 per cent. sol.), also adding it in the same way as the extracts to serum, with "positive" or "negative" results, after incubation. It occurred to me to try this decomposition product of lecithin, as very early in the course of this work it was found that cholin as well as cholesterol inhibited the action of lipase contained in pancreatic extracts, and lowered also the activating power of serum. It has proved satisfactory, and has the advantage also of simplicity and general availability.[2]

I use usually the saponified carcinoma mixed extracts and cholin, preferring not to rely on one method alone. Distilled water gives a turbidity also with carcinoma serum, but not so marked as with the extracts and cholin, although marked in the presence of fats in the cloudy serum. The turbidity does not appear with normal serum.

Directions in the Collection of the Blood.—It is of the greatest importance that care should be taken in the collection of the blood: (1) the blood should be taken while the patient is fasting, four to five hours after any solid or liquid, preferably before breakfast; as a rule 10 c.c. are taken from a vein in the usual way. (2) The needle; and all-glass syringe must be quite dry. Care must be taken that no water after sterilization remains in the needle or drawn up into the syringe after attachment of the needle; the piston of the syringe should be drawn up before the needle is attached and then the water expelled with a downward thrust of the piston; the needle should be detached from the syringe before slowly expelling the blood. Do not use a rubber attached needle for taking the blood, and do not use blood which may have run over from a punctured vein in failure to successfully insert the needle into the lumen of a vein. (3) The glass tube in which the blood is collected should be broad to readily permit separation of the serum; preferably the blood should be collected direct into a centrifuge tube; the serum should be clear and free from hæmoglobin; there should be as little manipulation of the blood and serum as possible; shaking of the blood clot and serum, for example, in transport must be avoided. (4) The serum should be centrifuged and examined within a few hours after separation; specimens kept in the ice-box for twenty-four hours are not satisfactory. (5) Pipettes should be free from all trace of alcohol or ether; if used more than once the pipette can be cleansed with distilled water which is then removed. (6) Note the colour of the blood-clot and serum. The blood in cancer is usually dark, sometimes almost black, and the serum opalescent and greenish. This is not pathognomonic, but is useful to note in conjunction with the serum reactions; similar coloration of the blood-clot and serum is witnessed in profound anæmia and anæmic conditions.

At first I was confronted with turbid serum. This not only made the test difficult but leads to inconsistent results. This difficulty of initial turbid serum due to incomplete digestion of fats after a meal is removed by the addition of 0·3 c.c. of glycerol coenzyme[3] first to 0·3 c.c. of the serum and after well mixing and incubation for two hours or so at 37° C., proceeding with the addition of each test solution. It is an additional precaution which I take if there is any suspicion of initial turbidity.

By means of these serum-reactions or blood-tests, it has been possible without any clinical knowledge of a case to differentiate cancer from non-cancerous cases in the majority of cases and, what is hardly less important, in obscure cases and after operation to exclude the presence of cancer. Up to the present in a total of 261[4] serums examined (including cancerous, non-cancerous, and normal) the method has proved correct in 248 or 95·3 per cent. The errors have been associated chiefly with tuberculous, sarcomatous, and febrile conditions. In one case (obscure abdominal) the reaction was "negative," but two months later, on post mortem and microscopic evidence, a primary carcinoma of the liver was found. So far

[1] The method of preparation of these extracts, procedure, and technique were more particularly described in my former papers; mammary carcinoma tissue (scirrhus), acetone dried in the usual way, has been mainly used, although I have used carcinoma and normal liver extracts as well. Usually 0·3 c.c. of the saponified extract in 1 in 3,000 and 1 in 5,000 dilution is added slowly to 0·3 c.c. of serum, so that the solution floats on the serum; accurate measurement is secured by the use of a micrometer screw pressure arrangement connected with a short stiff rubber tubing to a 1 c.c. pipette, graduated in tenths and hundredths. A normal serum is examined at the same time. (*Lancet*, October 7, 1922; *Medical Press and Circular*, January 3, 1923.)

[2] It can be obtained from Mr. W. Martindale, London. The crystals are hygroscopic and must be kept in stoppered glass bottles. A fresh solution should be made each time (0·1 gramme to 10 c.c. distilled water).

[3] *Preparation of Coenzyme Solution.*—Fresh pig's pancreas is freed from fat, minced and mixed with twice the amount of glycerol; after stirring and standing for twenty-four hours a turbid extract, strongly lipolytic in action (also tryptic) is obtained by straining through two layers of fine muslin. One part of this is added to four parts of water in a tall cylinder and the milky fluid allowed to settle; the fluid decanted from the precipitate when boiled and filtered and concentrated to a fifth of its volume contains the coenzyme of lipase, as shown by Rosenheim.

[4] I regret that illness for some months has prevented any material addition to my former list of cases and results. I am able now however to resume work as usual.

this is the only case of carcinoma, except one case of small superficial epithelioma in which the "positive" reaction has failed. In another case cirrhosis of the liver with ascites gave an erroneous "positive" reaction, in contrast to a "negative" reaction in more than one case of simple enlarged liver with jaundice, or gall-stones. The additional usefulness of the test has been demonstrated especially in obscure abdominal conditions and cancer of the stomach, as recorded in my original paper by Mr. Stanford Cade, of Westminster Hospital, to whom and other members of the Staff I am indebted for many blood specimens. So far as I have gone twelve cases of cancer of the stomach have been successfully differentiated from five cases of gastric ulcer, the diagnosis having been verified later.

Plate I illustrates the turbidity reaction in a case of cancer of the stomach, with the carcinoma extracts, and cholin, and cholin added after the previous addition of pancreatic coenzyme to the serum, after incubation, each result being compared with normal serum similarly treated. The patient was under the care of the late Mr. A. M. Crabtree in 1924, and under the observation of his brother and other practitioners. Clinically there was no question of the diagnosis, and the patient's very grave condition precluded any operative measure. Examination of the serum confirmed the clinical diagnosis. Intravenous injections of sodium oleate were commenced as a last resort. These were followed in a fortnight or so by amelioration of symptoms and mitigation of pain; the patient before long was able to leave his bed, to enjoy any kind of food and to take long walks; in fact for nine months he appeared to have recovered; treatment was left off, relapse and hæmorrhage occurred from which the patient shortly succumbed, without further treatment.

Plate II illustrates an absence of the turbidity reaction in a case of clinically suspected cancer of the stomach, reported by Sir W. J. Simpson [10]. It was that of a friend whose family history in regard to cancer was not a good one. He was suffering from gastric symptoms which suggested something more than simple ulcer. In the uncertainty of the diagnosis, exploratory operation was offered but this the patient was unwilling to undergo. In the still uncertainty, it was decided to examine the blood. The reactions to saponified mixed carcinoma extracts, ether extract alone, cholin, and water were absolutely "negative" to cancer. Two months later the reactions were found to be again normal; the patient had regained his former good health which has continued. The serum "negative" result with cholin is alone shown.

I am indebted to Mr. J. R. Ford for the accurate coloured drawings of the original test-tube reactions; to Messrs. Oliver and Boyd for the excellent and accurate blocks in reproduction; and to Messrs. Bale, Sons and Danielsson for the excellent printed illustrations of the same.

Another striking case is that of a friend who was at home from abroad. In this case also the family history in regard to cancer was not good. He was undoubtedly ill and unaccountably losing flesh rapidly. He desired especially to have his blood examined. The serum-reactions were entirely "negative" to cancer. The blood-clot was dark and the serum showed the greenish coloration of marked anæmia. He was advised to seek advice of a physician with experience in tropical disease, with the result that "amœbic cysts" were found, and under appropriate treatment he soon recovered.

In a more recent case among others the serum-reactions were found to be quite normal in a patient nine years after removal of her breast for scirrhus. On the other hand, it has been possible to decide as to the latency of the disease after operation. In two cases I found the "positive" reaction present twelve and eighteen months respectively after previous removal of the breast for scirrhus. The patients looked well and were apparently in good health, but within three months of that finding metastasis was only too evident in each case. In another case the reaction was present previous to a small local recurrence after operation for squamous epithelioma of ths skin, some twelve months before. These cases show that as long as the reaction persists the patient cannot be considered free of the disease.

It is not claimed that the reaction is specific and as I have already mentioned there is a 5 per cent. margin of error, but the practical utility of the reaction is not greatly affected and is evident in 95 per cent. proving correct. The reaction or test is in part associated with a marked cholesterol content in carcinoma serum as more recently shown by Mr. H. Gordon Reeves [11] in the Physiological Department, King's College. Further investigation on the chemical nature of the serum contents in carcinoma are in progress.

The defective tissue lipolytic action in cancer is witnessed in the case of other enzymes. As well known, antitryptic power of the serum is increased in cancer. This does not appear to be the same as the antitrypsin of normal serum, as the power of the former to resist heat is far greater. It has, moreover, long been known in the work of others that catalytic or oxidizing enzyme action of the blood and tissues is diminished in certain diseases such as tuberculosis, nephritis, and carcinoma.

In a former paper "On Cancer," by Professor E. Freund [12] (Vienna), it is stated that carcinoma extract with carcinoma serum and sarcoma extract with sarcoma serum respectively yield a specific turbidity or precipitation, whereas none occurs with non-carcinomatous serum and non-sarcomatous serum. Professor Freund has favoured me with his later published papers and details of his method with much useful information in correspondence. Briefly his test in carcinoma serum consists in extracting carcinoma tissue with sodium chloride and monobasic phosphate of sodium solution, and pressing the isolated cells through a fine cloth. The emulsion is heated with dilute acetic acid neutralized and filtered. It will thus be seen that his method though not the same as mine is partly dependent on a turbidity reaction. Kahn [13] has more recently described a turbidity test in which he uses sodium oleate in glycerol, which is not dissimilar to my test. It is of interest to note that he associates the reaction with inhibitory bodies in carcinoma serum against sodium oleate hæmolysis which is in line with the ascertained inhibitory action of cholesterol against sodium oleate, one of the substances which accelerate fat-splitting action, and with the marked presence of cholesterol in carcinoma serum.

Cancer Therapy.

We have thus arrived at the fact that there is a difference between normal and cancerous blood.

These changes are associated with defective normal enzyme action in the tissues, and in particular with defective tissue lipolysis. It has been shown furthermore that improvement and recovery are associated with increase of lipolytic activity in the blood and tissue.

In this direction, and restoration of physiological balance or control it seems evident that pancreatic

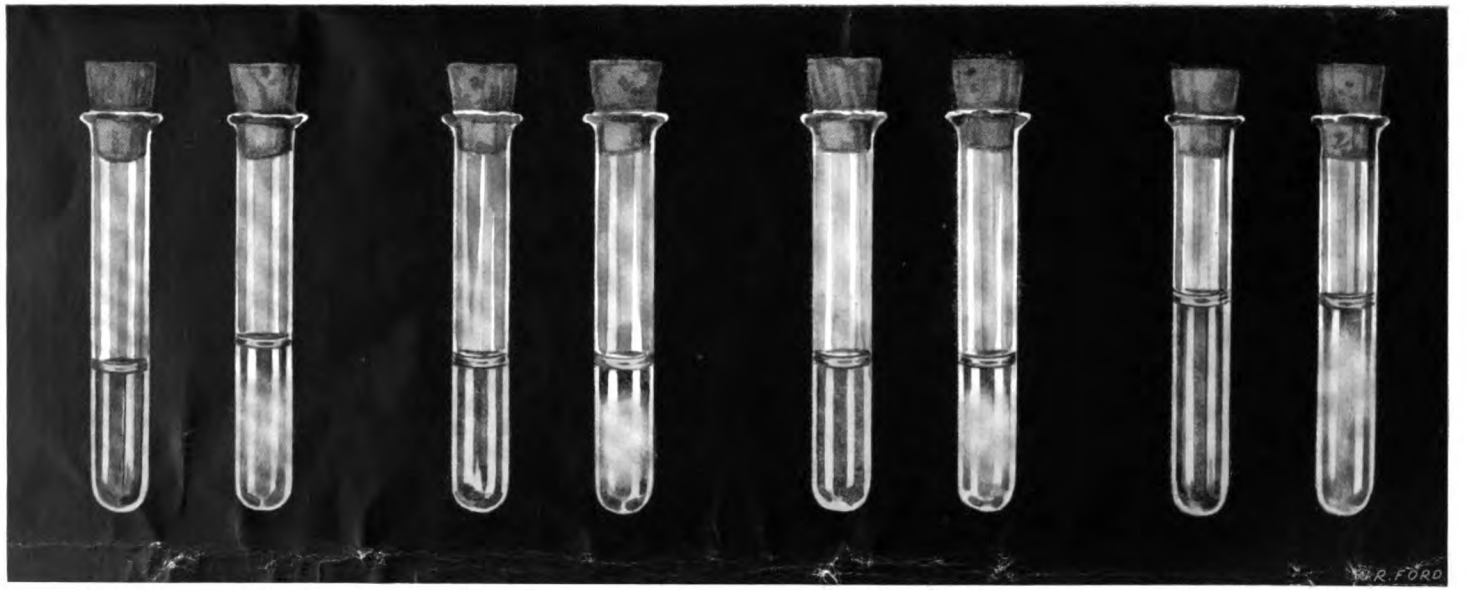
PLATE I.

SERUM TURBIDITY REACTION OR BLOOD-TEST IN CANCER.

The illustration shows a turbidity serum reaction from a case of cancer of the stomach.

The turbidity was produced by means of extracts of carcinoma tissue, with or without saponification (1) and (2), and cholin alone (3) and with coenzyme (4), added separately to the serum—after incubation, each result being compared with normal or non-cancerous serum, similarly treated.

Saponified alcohol, ether, and chloroform carcinoma mixed extracts, added.	Ether carcinoma extract, added.	Cholin, added.	Cholin, added after addition of glycerol coenzyme (lipase) first to the serum.
1	2.	3.	4.



Normal. Cancer. Normal. Cancer. Normal. Cancer. Normal. Cancer.

J. A. Shaw-Mackenzie—Study in the Diagnosis of Cancer by means of Serum Reactions.

PLATE II.

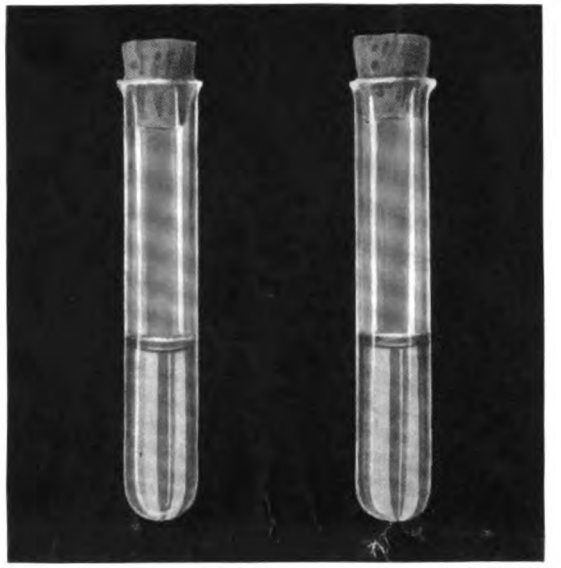
SERUM TURBIDITY REACTION OR BLOOD-TEST IN CANCER.

The illustration shows an absence of the turbidity reaction from a case of clinically suspected cancer of the stomach.

The serum is left as clear after application of the test (see Plate I) as the normal serum similarly treated. The serum was found to be again normal two months later, with regain of the patient's former good health.

The absence of reaction with cholin is alone shown, but the saponified and ether carcinoma extracts in each case gave the same "negative" result.

Cholin, added.
1.



J. R. FORD

Normal. Suspected. (Non-Cancerous.)

J. A. Shaw-Mackenzie—Study in the Diagnosis of Cancer by means of Serum Reactions.

coenzyme and other activators of lipase, with its normal fatty acid protective products, e.g., sodium oleate, extracts of normal organs and of carcinoma tissues and serum, are indicated in treatment.

Sodium Oleate.—I drew attention formerly, and on many occasions since, to the work of the late J. H. Webb [14] of Melbourne. He obtains good results by subcutaneous injection of sodium oleate in cases of inoperable cancer, and sent me notes of many cases to which, with details of treatment, I drew especial attention in 1906 [15]. The dosage recommended or worked out is 30 to 60 minims of a 0·8 per cent. sterile solution of sodium oleate; this is injected subcutaneously in sound tissue in the neighbourhood of the growth, preceded by a little eucaine; the injections are repeated every fourth day or so; in addition dried ox-gall which, like the well-known action of bile salts, is a powerful activator of lipase, is given by the mouth, in five-grain doses two or three times a day, in cachet, or in mixture of one-drachm dose of glycerol with cardamoms and peppermint water. The dosage is regulated so as to have a moderate action on the bowels. More recently favourable results have been recorded by Drs. S. Blakely and W. E. M. Armstrong [16], and by Dr. A. Wilson, in inoperable breast carcinoma. In addition to the notes of the carcinoma of the stomach, treated by intravenous injections of sodium oleate (Plate I), a practical proof of the value of this method has been forthcoming in a previous case of carcinoma of the stomach treated in this way with apparent recovery, which I have recorded. The patient at the time was under the care of Dr. A. L. Grant, of Burghead, Morayshire, in 1922, now in practice at S. Pasadena, California. Here there could be no question clinically of diagnosis, and from the point of view of therapeutics in control of reputed "cures," the reactions of the serum were precisely the same as in Plate I. When I examined the blood a year later in the Northern Infirmary, Inverness, these reactions were almost completely absent. The patient is in good health at the present time (three years).

The dosage of sodium oleate by intravenous injection employed in these cases is 1 to 3 c.c. of a one per cent. sterile solution of sodium oleate, weekly, to start with; 2 c.c. of a two or three per cent. strength appear to be well tolerated. There is no doubt sodium oleate has a favourable influence over some forms of cancer but a sufficient number of cases treated in this way would have to be forthcoming. Nakahara [17] has recently noted the fact that by means of oleic acid and of sodium oleate previously injected in small amounts the proportion of growths in inoculated tumour mice is lessened by almost one half and the course of established growths also is considerably modified. He shows that the immunization is associated with a general lymphoid tissue response and increased activity in the spleen and lymph glands. He refers also to the many views of others that the lymphoid cells are concerned in the digestion of fats and lipoids. In two cases I have recorded disappearance of ascitic or pleuritic fluid secondary to carcinoma of the breast with disappearance of the disease itself, in the former case involvement of the liver. After repeated ineffectual tapping the fluid seemed to "empty itself" by the kidneys. A similar disappearance of cancerous ascites has recently been mentioned to me. In two of the three cases, the patients were undergoing sodium oleate treatment. It is a point which suggests further attention to diuretics as aid in treatment, and the possible influence of the kidney in cancer metabolism. The assumption in Webb's recommendation of sodium oleate was a deficiency of the bile-salts and soaps with consequent separation of cholesterol as a determining factor in the cell proliferation of cancer; this took place either locally from injury or irritation or from some functional disturbance in the liver. Increase in cholesterol content in the cancer cell together with increase of lecithin which has long been pointed out is found also in the fatty deposits in the subcutaneous tissues and mesenteries of carcinoma cases (Brailsford Robertson and Burnett [18]) and in the neighbourhood of a growth, as well as noted already in carcinoma serum. It is not improbable that the liver is in some way responsible for this widespread distribution in association with unsaturation of the fatty acids with which the liver is intimately concerned. It is not impossible that this organ in the same way may be responsible for the separation or production of the fatty acid factor or coenzyme in cancer blood and cancer tumours. Adipose tissue is rich in catalases. Oxidation of unsaturated fats has been shown by Hopkins [19] to be readily catalysed by "glutathione" isolated by him from yeast and animal tissues, acting by virtue of its chemical structure as a means of hydrogen transport within the cell.

Normal, Carcinoma, and other Pathological Tissue Extracts.—In view of the above and that the phosphorized fats (lipins) and derivatives might be more important than ordinary fats, I prepared, with a view to treatment, extracts of the liver and extracts of carcinoma tissue, in the same way as for diagnosis. Protein derivatives, and acid-meta-proteins were made also. These have marked activating power on fat-splitting *in vitro* and *in vivo*, but no conclusions, clinically, can yet be drawn in this experimental stage. Similar extracts were prepared from tuberculous tissue.

Serum.—(1) Animal sera are more powerful in activating lipase than human serum. Dr. A. Wilson [20] has recorded some striking results with goat serum injected in cases of inoperable cancer, one of which results I witnessed. (2) Auto-serum, or the patient's own blood-serum, gave me, at one time, encouraging results. Two inoperable cases—uterus and breast—apparently recovered under this method and remained well. The breast case returned ten years later with recurrence and hopeless involvement of the pleura. Her history was that for nine years she had been in good health and free from any evidence of recurrence. (3) Anti-serum. In 1913 [21], I inoculated rats with mouse tumour, and goats and sheep repeatedly with human carcinoma material, as well as separately with carcinoma serum alone. After some six inoculations the serum power on lipase was reduced; this reaction was shown to run parallel with that of anti-diphtheritic serum as previously

ascertained; injections of anti-diphtheritic serum in cases of diphtheria are followed by a marked rise in lipolytic activity of the blood coincident with improvement. This method of obtaining serum by repeated inoculation of animals (sheep) with cancer material was originally introduced by the late G. Carrington Purvis, of Grahamstown. Lately, Dr. T. Lumsden [22] has shown that the serum of animals—rats and rabbits—repeatedly inoculated in the same way, with mouse tumour, is destructive to mouse tumour cells *in vitro*.

The clinical side has still to be investigated. One point needs consideration. The response to produce an effect was found in my experiments to vary in the different animals. The sheep was more responsive than the rat, goat, and, in a few experiments, rabbit. The question arises whether the horse or cow might be more suitable.

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GRANULOMA VENEREUM.[1]

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GRANULOMA VENEREUM, also described as granuloma pudenda, granuloma inguinale, ulcus molle serpiginosum, is thought to be rare in the Malay Peninsula. On the contrary, it is frequent enough to deserve more attention at the hands of the profession. Besides, we meet in this country other diseases such as syphilis and yaws that are often characterized by granulomatous lesions, and therefore it is necessary that confusion should be avoided.

Definition.—Granuloma venereum may be defined as a disease of the external genitals and adjacent parts, characterized by granulomatous tissue formation and going to ulceration and cicatrization, pursuing a very chronic course and invariably following impure sexual contact. It is therefore preferable to call it granuloma venereum, although it is not a venereal disease in the sense of gonorrhœa or syphilis.

Distribution.—The disease was at one time thought to be peculiar to the tropics, and hence called granuloma inguinale tropicum. Now, however, it has been described by so many observers in various parts of the world that it may be said to be almost universal.

Ætiology.—The true ætiology of the disease has not been definitely established. Some authors have described the disease as a tubercular ulceration, others have described what are called "inclusion bodies" in the mononuclear cells, and yet others consider it a syphilitic process. Judging from the character of the lesion in the cases that have come under my observation and the response to treatment with antimony, a drug allied to arsenic, it is likely the infecting agent is a spirochæte of the Treponema group.

Race, Age and Sex.—All my patients were Chinese and Tamils of lower classes—not very particular about their personal cleanliness. I do think that the habits of the individual and the nature of secretions such as sweat, &c., of the external genitals has more to do with susceptibility towards the disease than age or sex. All were adult males above 25 years of age, a factor in support of sexual contact in the ætiology of the disease.

Incubation Period.—This is very indefinite and varied from a few days to three or four months.

Mode of Spread.—The usual history is, that following an impure sexual contact the disease appeared in some part of the external genitals. But in some cases it appeared to me that it spreads also by auto-inoculation. In one case the patient developed a granuloma on the prepuce and a few weeks later developed a similar lesion on the lower third of his left thigh. It is likely the lesion in the thigh started as an ordinary ulcer which later got infected from the discharge of the original lesion.

Clinical Appearance.—The lesion generally starts as a papular eruption about the external genitals, groins or the perineum, and develops either into a granuloma, or it ulcerates and follows a serpiginous course with irregular and undermined edges. In either case, while the lesion extends along the periphery the central or distal portions are found to heal and cicatrize firmly. The cicatrix is often pale and leathery in consistence. What may appear to be a healthy scar one day may be seen to ulcerate the next. Lesions about the groins may extend to the pubis and the lower abdomen and the flanks, those about the root of the penis may ulcerate all round and

[1] Paper read before the Annual General Meeting of the Malaya Branch of the British Medical Association, held in Kuala Lumpur, on April 11, 1925.

isolate the penis from the rest of the external genitals; those that appear about the lateral aspect of the scrotum generally follow the genito-crural folds and extend towards the perineum and the anal region. In all cases there is profuse serous discharge. The disease pursues a chronic course for weeks, months and years, apparently responding to treatment but only to break out soon after. The general health gets gradually lowered. The chronicity of the disease, the profuse discharge, and the poor response to treatment begin to be felt and the patient becomes depressed, worried and apathetic and some cases develops a suicidal tendency. The patient goes from one practitioner to another and drags on a miserable existence. Some cases, for some unknown reason, take a turn for the better and heal spontaneously.

Diagnosis.—This may be done on the finding of the so-called "inclusion bodies," but one should be guided more by the clinical appearances, history and response to treatment than by microscopical findings which are as yet uncertain.

Granuloma venereum has to be differentiated from yaws, syphilis, epithelioma and tuberculosis. It can easily be differentiated from yaws by the history and the ready response to treatment by N.A.B., and by the fact that yaws is prevalent among the Malays and rarely in other races and attacks all ages and sexes; from syphilis by the absence of a positive Wassermann and the failure to respond to antiluetic treatment; from epithelioma by the absence of characteristic microscopical appearances of tissues excised from the lesion; from tuberculosis by the absence of tubercle bacillus, and by its being limited only to the external genitals.

Prognosis.—This is very unsatisfactory, but with the introduction of antimony there is better prospect of improvement and cure. However, the disease is very refractory to treatment, and patients are not usually intelligent enough to undergo prolonged treatment.

Treatment.—Until recently reliance was placed on local treatment by means of caustics and in the administration of drugs of antisyphilitic nature, with little or no success. The successful employment of tartar emetic in the treatment of trypanosomiasis has encouraged its use also in granuloma venereum. I have administered the drug both by the intravenous route and by the mouth, more frequently by the latter. The salt used was the tartrate. The dose employed to start with was ½ gr., gradually increased to 2 gr. once in three days intravenously. After a course of eight to ten injections the drug was stopped for at least a week and then repeated. The results were not as satisfactory as I was led to believe from the reports of other observers. Therefore I used the drug in combination with large doses of potassium iodide by the oral route, beginning with 1 gr. and 15 gr. and working up to 2 gr. and 1 drm. respectively. The results were more satisfactory and the healing more rapid.

My observations lead me to conclude:—

(*a*) That the dose of antimony tartrate by the intravenous route should not exceed 1 gr. at one time and must not be repeated oftener than once in three days.

(*b*) That it is best to administer the drug in combination with potassium iodide by the oral route along with the intravenous injections.

(*c*) That intravenous injections of antimony tartrate should not be undertaken lightly, and that individual susceptibility should be carefully watched for and the injections discontinued on the evidence of any adverse symptoms.

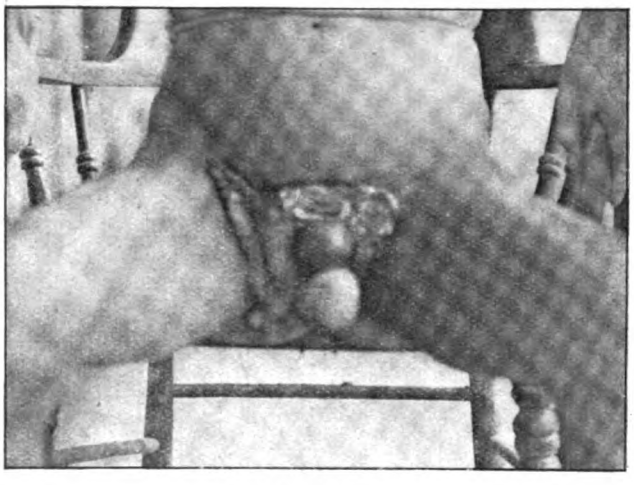


FIG. 1.

Local Treatment.—Scraping and cauterizing were useless. Excision of the lesion, keeping well out of the advancing area of ulceration, was done with doubtful result. Better results are likely to be had if every endeavour is made to keep the lesion and the adjacent parts dry. For cleaning the lesions it is best to employ mild astringent antiseptics in preference to strong lotions.

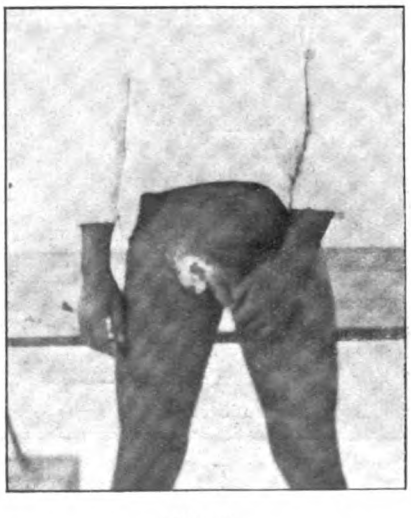


FIG. 2.

To summarize:—

(1) Granuloma venereum is not a rare disease in Malaya.

(2) It is certainly a sequelæ to impure sexual contact, and in that sense it may be classified as a venereal disease.

(3) In treating the disease early diagnosis is essential to success.

(4) Tartar emetic alone is not likely to give as satisfactory results as its combination with potassium iodide in large doses.

(5) Utmost care must be taken to keep the parts as dry and clean as possible.

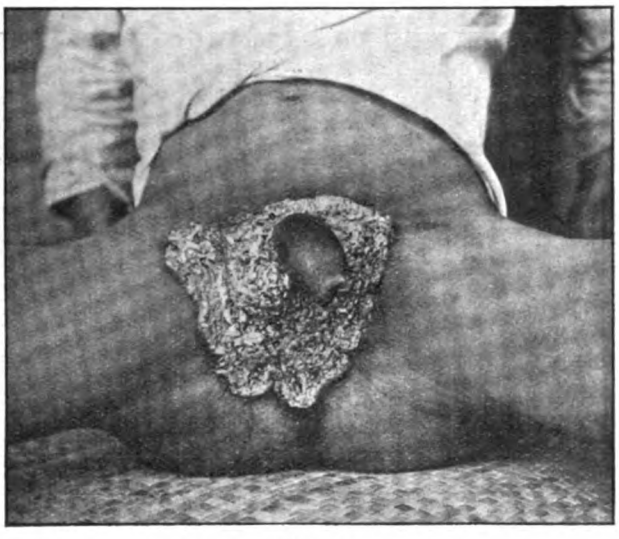


FIG. 3.

(6) Patients under antimony treatment, by whatever method the drug may be administered, must be closely watched for any adverse symptoms and the drug discontinued immediately they appear, as it is well known that prolonged administration of this drug leads to fatty degeneration of the liver, kidneys, &c., and patients not infrequently complain of severe pain in the hepatic region soon after injection.

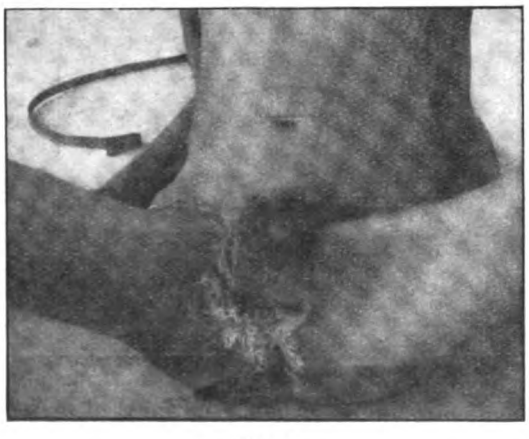


FIG. 4.

Fig. 1.—A Tamil, first seen in 1917, with a large granuloma inguinale in the right groin, said to have appeared as a pimple some weeks after an impure sexual contact.

Local applications of strong lotions and scraping and antiluetic treatment for three months with no benefit. Patient left hospital dissatisfied.

Seen later, in 1919, clinical picture same as before. Patient placed on the following mixture on October 27, 1919:—

℞ Pot. Iodide ...	...	Gr. 30
Antim. Tart.	...	,, ss
Aqua Chloroform ...		Oz. 1
Fit. Mist. Sig.	...	,, 1 T.I.D.

The ulcer was dressed with pulv. iodof. The pot. iod. was gradually increased to 60 gr. and the tartar emetic to 1 gr. t.i.d. Three intravenous injections of antim. tart. 1 gr. once in three days was given.

After the third injection patient was collapsed and doubled up with pain in the hepatic region within almost half an hour. The injections were discontinued from this date. On January 8, 1920, signs of healing appeared in the centre of the lesion, and on March 2, 1920, patient left hospital with a pale but healthy leucoderma-like scar of leathery consistence.

Fig. 2.—Chinese male, 35 years of age.

Admitted on May 8, 1920, for serpiginous ulceration of one year's duration, said to have started in the right groin twelve days after impure sexual contact, and to have extended along the genito-crural fold to the root of the scrotum, the perineum and anal regions. Left hospital on June 15, 1920. Treatment similar; but patient had 6 gr. of tartar emetic intravenously on twelve occasions.

Fig. 3.—Chinese (an opium smoker), admitted on January 13, 1921, with granulomatous ulcerations involving the pubic and genito-crural regions, the scrotum and perineum. Said to be of fifteen months' duration and to have developed as a small sore at the root of the penis four months after impure coitus. The growth presented a typical cauliflower appearance with indurated and elevated edges. Before patient came under my observation the lesion was diagnosed as epithelioma, and was treated by caustics and later by actual cautery on February 19, 1921.

Intravenous injections of tartar emetic, ½ gr. once in three days. was started and given on and off till June 12, 1921. Patient was also given pot. iodid., 20 gr. t.i.d.

On July 15, 1921, patient left hospital. Fig. 4 shows his condition on discharge.

A Typical Case of Splenomegaly (I. Treiger, M.D., *Archives of Internal Medicine*, May 15, 1925).—A woman, aged 60, who had had typhoid fever at the age of 10, and eclampsia at 31, nineteen years ago, received a diagnosis of enlarged spleen. The present findings were a greatly enlarged spleen and liver. The blood-findings were anæmia and leukopenia until a few months ago, when leukocytosis, with myeloid changes, appeared. The course of the disease was divided into the three stages, splenic, hepatic and myeloid; the first stage lasted over a period of twenty years, the second over a period of a few years and the last has been in evidence for nine months. The spleen, liver and bone marrow are interrelated in their function. This case represents a pathologic correlation of these three, while usually only involvement of the spleen and liver is seen.

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AUGUST 15, 1925.

MASSAGE BY CHINESE METHODS, ANCIENT AND MODERN.

As long ago as 1891 and 1892 I attended two lectures on Chinese methods of massage by Dr. John C. Thomson, M.A., M.D., Edinburgh. Dr. Thomson recently taught as superintendent of the Alice Memorial Hospital of the London Missionary Hospital, Hong Kong. The "Alice" referred to was the late wife of Kai Hokai, who, after a course of instruction at the medical school of St. Thomas's Hospital, London, had graduated at the University of Aberdeen as M.B. and C.M., and later took the degree of M.D.Aberd. At the same time as Hokai ate his dinners at the Middle Temple in London he was called to the Bar and practised law before the High Court at Hong Kong. As a public man in many walks of life, Hokai was knighted and styled Sir Kai Hokai.

When Dr. J. C. Thomson began his lectures on early Chinese massage he dated the period from an epoch some 4,000 to 5,000 years before the Christian era and elaborated throughout the succeeding thousands of years to more modern times a chain of events which in its course showed the elaboration of massage in more modern times. In Europe these methods led to greater skill, and it was many hundreds of years of development before so-called modern methods of massage began to come to the front in Swedish and other systems of muscular development. Not that the ancient systems were neglected. Not so; every branch of surgery was maintained and new plans brought forward; for, as Dr. Thomson says, the Chinese themselves draw a very fine distinction between internal medicine and external medicine, as they term surgery. I have in my entrance hall in Harley Street "boards of testimony" presented to one of the Chinese heroes of surgery who, 4,000 years ago, performed abdominal surgery with delicate elaboration and success. One of these was presented to me as a fitting testimony for my having done removal of an ovarian tumour as skilfully as it was done 4,000 years ago by the great Chinese surgeon. Surgery was then far advanced. There was some knowledge of the circulation of the blood. The operation of castration had been successfully performed by the year 1100 B.C. Methods of cure by massage had been boldly and skilfully practised, and already syphilis was being cured by mercury.

In ancient medicine, as in everything else in China, specialization reached its acme. There were doctors for the eye, chest, bowels, skin, women, children, bone-setting.

The summary of these possibilities in China 4,000 years ago are to be met with to-day amongst American curers, oculists, dentists, neuropathists, bleeders, faith healers, and a host of such wise men and women, snake charmers, &c., &c.

The massage (say Swedish) of to-day, or amongst Japanese, was originally such as is dealt with in systems of to-day amongst Chinese and Japanese and Swedes, consist of muscular movements, and are of several kinds. The Chinese had originally twelve kinds.

CHINESE MOVEMENT CURE.

The sixth operation of surgery, which I have rendered "Shampooing," is worthy of more than passing notice, since in addition to the general idea

of massage it has developed into a science resembling in some respects, and rivalling in detail at least, the now famous Swedish Movement Cure. Massage in its simpler form, consisting of tapping, kneading, pinching, chafing, and pommelling the body all over, is widely used as a remedy for muscular fatigue, nervousness, headache, paralysis, pelvic disorders, labour, &c., and also as a simple luxury, the barbers being the operators and concluding their daily shaving and dressing operations with a sound pommelling to the back and limbs of such of their patrons as can afford to pay for it.

This, as well as the more complicated system of massage combined with air-swallowing and muscular exercises, is of great age, being traced not to the usual Hwang Ti (2697 B.C.), legendary though that emperor be, but some twelve centuries beyond him. Into the history of the system, however, I shall not here enter, referring for that and for a full description of its theory to a paper on the subject by D. J. Macgowan, M.D., Wênchow, in the Customs Medical Report, No. 29, 1884-85; and here passing directly to a brief account of the frictions and movements themselves, taken from that paper.

The period of air-swallowing and friction exercises is to be divided into three parts of one hundred days each. After certain preliminary carefully described inhalations of the sun's air on the first of the moon, and of the moon's air at the full moon, all is ready for a commencement being made. During the first month friction is to be made by two youths, each on alternate days, they rubbing the patient's abdomen with the right hand and from right to left, at first lightly, but gradually increasing the pressure, and this for an hour three times daily. By the end of the first month the services of the youths may be dispensed with, when a form of shampooing is to be practised by the patient himself, thumping his ribs with a bag filled with water-worn pebbles, weighing a pound, three times daily. During the third month a pestle about six inches long, or a round bat somewhat longer, is to be employed for pounding the abdomen three times a day; they are to be made of hard wood. Meanwhile friction and pounding the ribs is to be continued. During the fourth month the bat and pestle are to be alternately used along with friction, and this completes the first period of one hundred days.

From the fifth month of the exercises the bag of pebbles is to be used continually till the close of the eighth month, which closes the second period of a hundred days. During the third period the back is to be pounded in like manner. During the whole three hundred days it is directed that continence be maintained, except once between the hundred-day periods; and ever afterwards, except once in fifty days.

"I. Stand erect and firmly, retain the breath, bring the flexed hands together on the chest, knuckles meeting, keeping the mind at absolute rest.

II. Stand on the toes and extend the arms literally, with eyes fixed, mouth closed, and mind perfectly quiescent.

III. Maintaining the tiptoe posture, raise the arms above the head and bring the hands together with palms turned upward, joints closed, tongue pressing roof of mouth; clench the fists and bring the arms firmly and slowly down.

IV. Raise one arm above the head, palm hollowed, eyes directed towards it, inhaling through nostrils, and forcibly and slowly bring down the arm. Repeat with the other arm.

V. As if pulling the tails of nine bulls, stand on one foot bent and extended forwards, the other extended backward; cause the air of the pubic region to move forcibly, thrusting one arm forward, the other backward, eyes fixed on the clenched fist. Repeat, reversing the legs.

VI. Extend the arms forward, as if pushing out and drawing in, seven times.

VII. Head inclined, with a hand stretched behind the neck. Repeat with other hand. Maintain erect posture, with gentle breathing.

VIII. Sit with legs wide apart, pressing the hands on the floor, and forcibly raise them, eyes fixed, mouth closed; rise and bring the feet together.

IX. Turn the arms alternately across the chest, fixing eyes on the hands, the mind meantime settled.

X. Assume the posture of the "crouching tiger," one knee bent, the other stretched backward, head turned upward, palms resting on the ground.

XI. Bend forward, placing the hands at the back of the head, so as to cover the ears; close the teeth, press roof of mouth with tongue.

XII. Finally, keeping legs erect, bend forward, with fixed eyes and upturned head, the hands clasped on the ground; rise; stamp twenty-one times, and stretch the arms alternately seven times; then sit cross-legged, each leg in turn, with closed eyes.

The above exercises are to be performed three times daily for an indefinite period."

In the year 1895 I read a paper before the China Society, and gave a demonstration. The China system was read out of one paper, whilst I gave an exhibition of the British system and also the Chinese massage.

Beyond alteration in the terms applied to the movements of the limbs and body, but few changes are to be made. For instance, when the "command" is given, "Assume the *posture of the crouching tiger*," or "*as if pulling the tails of nine bulls*," &c., and such other orders.

J. CANTLIE.

(To be continued.)

[1] *China Medical Missionary Journal*, vol. iv, p. 186; "Customs Medical Report," No. 29, p. 42.

Annotations.

The Fight against Malaria at Madagascar (Thiroux, *Bull. de l'Office Internationale d'Hygiène Publique*, January, 1925).—Malaria is one of the greatest causes of the decrease in the population of Madagascar. It appears to have always been prevalent on the coast and especially in regions of medium altitude. On the Plain of the Grande-Ile, however, malaria is of relatively recent origin, possibly between 1902 and 1904. In Antananarivo alone malaria has been the cause of 11,337 deaths since 1905. The average annual number of deaths from malaria during the last sixteen years is roughly 500 in a population of less than 60,000 people. Malaria is prevalent in active form during seven months of the year, affecting three-fourths of the population ; with the coming of the cold season it is not surprising that these enfeebled people do not resist the pneumonia and influenza which invariably set in. The largest number of patients suffering from pulmonary infections are found in malarial districts. Prophylactic measures already carried out have borne good results, but much yet remains to be done to rid the country of one of its worst scourges.

Plague Transmission through the Ectoparasites of the Tarabagan (W. Lien Teh, J. W. H. Chun and R. Pollitzer).—The authors have succeeded in infecting a healthy animal by means of tarabagan fleas, which shows that these parasites play an important part in the spread of the infection, not only from animal to animal, but also from animal to man. Observations on the lice and fleas from one and the same naturally infected tarabagan is certainly illustrative of their important link in the propagation of the disease from animal to animal. It is at present difficult to gauge how far the lice actually spread the disease to man. A few outbreaks, where the affected had contact with tarabagan skins only, seem somewhat suggestive of their rôle. Observations made both on the fleas and the lice thus show that any attempt to control the handling of tarabagans and the trade with their skins must include not only bactericidal, but also insecticidal measures.

The Effect of Fatigue upon the Susceptibility of Rabbits to Intratracheal Injections of Type I Pneumococcus (G. H. Bailey, *American Journal of Hygiene*, March, 1925).—Fatigue artificially induced in rabbits by forcing them to walk for periods of one, two or three successive periods in a motor-driven drum seems to decrease their resistance to intratracheal injections of Type I pneumococcus. This occurs whether fatigue precedes or follows the injections, but is more evident in the latter case. The increased susceptibility of rabbits fatigued in this manner is shown by a considerably higher mortality, as well as a shorter mean time of death. This is more evident when fatigue follows injection than when injection follows fatigue. Forcing rabbits to walk in a motor-driven drum from six to twelve periods on alternate days before injection, during which time they become well trained to such exercise, apparently increases the resistance of these animals to injections of Type I pneumococcus. The gross pathological lesions indicate that more extensive pulmonary lesions occur in fatigued rabbits injected intratracheally with Type I pneumococcus than occur in unfatigued controls.

Contributions to the Pathology of Experimental Virus Encephalatis. (1) "An Exotic Strain of Encephalitogenic Virus" (S. Flexner and H. L. Amos, *Journal of Exper. Med.*, February 1, 1925).—In this paper is given an account of an inoculable virus disease produced in the rabbit with cerebrospinal fluid taken from a case of vascular and neural syphilis. The study which yielded the results presented was undertaken in the course of an investigation into the ætiology of epidemic or lethargic encephalitis. Twenty-seven samples of cerebrospinal fluid, derived from cases of epidemic encephalitis, were tested upon rabbits without positive results. The one successful instance in which an inoculable disease was produced arose from the injection of one of three specimens of the cerebrospinal fluid taken from the case of syphilis. Following this success, two subsequent injections of the fluid, taken from the same patient were made unsuccessfully. The name virus encephalitis is proposed for the experimental disease produced in rabbits by the inoculation of the herpes and allied viruses.

Skin Infection of Rabbits with Hæmolytic Streptococci isolated from a Patient with Erysipelas (T. M. Rivers, *Jour. of Exper. Med.*, February 1, 1925). —Small areas of skin infiltrated with immune serum proved refractory to the injurious action of a filterable rabbit virus inoculated twenty-four to forty-eight hours later. Infiltrations of normal serum did not appreciably protect the skin against the virus. The local protection afforded by the infiltrations of immune serum appears to constitute an example of local passive immunity. Small areas of skin infiltrated with either normal or meat infusion broth proved more refractory than normal skin to infection with hæmolytic streptococci inoculated twenty-fours later. The refractory state induced in the tissues was not specific in character. A greater amount of local protection against hæmolytic streptococci was afforded by infiltrations with a hæmologous immune serum than by infiltrations with normal serum. The difference in the amount of protection afforded by immune serum over that induced by normal serum may be thought of as representative of the degree of local passive immunity conferred.

A Certified Milk-borne Paratyphoid Outbreak (Huntington Williams, *Jour. Amer. Med. Assoc.*, January 24, 1925). – During March, April and May, 1924, there occurred an outbreak of paratyphoid fever among a group of about sixty infants and young children in New Rochelle, N.Y., and nine neighbouring communities. There were no fatal cases. During

the preceding December there had occurred in the near-by city of Mount Vernon a small group of cases of similar clinical nature. The characteristic symptoms of the outbreak were: a green, mucoid, blood-tinged diarrhœa, with fever, abdominal pain, and occasionally vomiting. The clue to the correct ætiology of the outbreak was the isolation of *Bacillus paratyphosus* B from the stool of one of the children during convalescence. The diagnosis of the clue was followed by isolating the paratyphoid organism from three other convalescent children. In addition, there were two cases giving positive Widal reactions and four other cases giving partial Widal reactions with *B. paratyphosus* B. There was no common vehicle of infection other than the certified milk that had been consumed in all the cases. The outbreak was caused by an enteric carrier of *B. paratyphosus* B, who was a milker employed at the dairy farm producing the milk in question. The ætiologic organism was isolated from the stool of this carrier and also from the stool of his 4-year old child. Only one previous outbreak of infectious disease spread by certified milk is known: a diphtheria outbreak that occurred in Westchester County, N.Y., in 1920.

Observations on Inoculated Malaria (A. Pijper, M.D., and E. D. Russell, M.R.C.S., L.R.C.P., D.P.H., *South African Medical Record*, May 9, 1925).—In *early* cases of simple tertian malaria an injection of neosalvarsan is a *therapia magna sterilisans*. An injection of neosalvarsan has a provocative action on latent malignant tertian malaria, whilst curing a simple tertian infection. Daily red-cell counts in inoculated simple tertian malaria show a marked incubational increase in the number of red cells, and this was confirmed by daily determinations of the percentage volume of the red cells. Malignant malaria acts likewise. Not all cases of general paralysis show an increased sedimentation rate of the red cells. Korteweg's observations on the "initial fever" of simple tertian malaria are confirmed. The type of fever with which simple tertian malaria begins depends on the state of immunity of the subject. Simple tertian malaria paroxysms are the expression of a state of allergy, both in first attacks and in relapses, or later reinfections. Spontaneous cures occurred in a large percentage of these cases, and this is to be ascribed to acquired immunity. South African natives often show a marked immunity against inoculated tertian malaria. Inoculated simple tertian malaria causes a mild leukopænia, and the leukocyte curve on the whole runs parallel with the parasite curve. Certain deductions as regards immunity can be made from the relative height of the two curves. The incubation period is not dependent on the number of parasites inoculated. During the course of malarial infection enormous number of parasites are destroyed, but the number does not seem to stand in any fixed relation to the immunity reached. High rises of temperature are associated with large numbers of parasites in the blood.

Many of the author's observations suggest a particularly active participation of the bone-marrow in the pathogenesis of malaria.

A Group of Micro-organisms transmitted hereditarily in Ticks and apparently unassociated with Disease (E. V. Cowdry, *Journal of Experimental Medicine*, June 1, 1925).—Pleomorphic, bacterium-like, Gram-negative intracellular micro-organisms, which stained much less intensely with ordinary dyes than most bacteria, were found in sixteen species of ticks comprising examples of the Argasidæ and the Oxididæ. In six of these species studied intensely slight differences in the micro-organisms were detected, sufficient to permit identification of the vectors by microscopic examination of the micro-organism alone. No evidence was seen of injury to the tissues of the arachnid hosts of the micro-organisms other than that incident to mechanical distention of the cells containing them. The detection of the micro-organism in the eggs of ten species in the unfed larvæ of eight species, and at nearly related stages throughout the life cycle of three others, leads to the conclusion that they are transmitted hereditarily.

The Liver as a Source of Bacterial Agglutinin (F. S. Jones, V.M.D., *Journal of Experimental Medicine*, June 1, 1925).—Serum and tissues containing agglutinin for the hog cholera bacillus may be dried *in vacuo* over sulphuric acid without appreciably injuring the antibody. The desiccated material when extracted with appropriate amounts of distilled water offers a basis for accurate comparison of antibody content. The greatest concentration of agglutinin occurred in the liver, provided the animals injected with small amounts of antigen were killed within a short period. The serum of those more highly immunized contained the highest concentration of antibody. A single injection of antigen into a radicle of the mesenteric vein resulted in a considerable concentration of agglutinin in the liver. Other experiments indicated that the liver does not act as a reservoir for the antibody. It has also been shown that this concentration of agglutinin cannot be ascribed to the blood left within the liver, since the blood serum was relatively poor in antibody. The experiments indicate that the agglutinin was produced within the liver.

Skin Reactions to Simultaneous Treatments with Radiant Heat and Soft X-rays (James A. Hawkins, Ph.D., and Harry Clark, Ph.D., *Journal of Experimental Medicine*, June 1, 1925).—Guinea-pigs have been exposed to suberythema doses of soft X-rays, to radiant heat of intensity at about critical for producing slight burns, and to both radiations simultaneously. No erythema was produced in the skin of the animals exposed to X-rays alone and only slight burns resulted in 50 per cent. of the animals exposed to heat radiation alone. The

animals exposed to heat and X-radiation simultaneously developed well-marked burns which healed much more slowly than those produced by heat alone.

A comparative study of the environment associated with Kala-azar prevalence in Calcutta (L. Everard Napier, M.R.C.S., L.R.C.P., *Indian Journal of Medical Research*, April, 1925).—In order to summarize, it can be said that, as far as Calcutta is concerned, kala-azar seems definitely to be associated with: vegetation in close proximity to the dwellings, earth unprotected by cement or paving stones in and around the dwelling; ground floor residence, possibly with insanitary conditions, especially with reference to the presence of fowls and ducks in and around the dwelling, and within the endemic area, and with masonry houses (rather than bamboo and khola huts).

Studies on Lathyrism—I (L. A. P. Anderson, Albert Howard and J. L. Simonsen, *Indian Journal of Medical Research*, April, 1925).—The seeds of khesari (*Lathyrus sativus* L.) have been found, on chemical examination, to be free from substances of alkaloidal nature. Controlled experiments with this seed over long periods with ducks and monkeys have demonstrated that the grains are harmless and provide a nourishing diet for these animals. An examination of the weeds which contaminate khesari has proved that akta (*Vicia sativa* L. var *angustifolia*) contains bases showing alkaloidal properties. Two such bases, vicine and divicine, and a cyanogenetic glucoside vicianin, have been isolated, prepared in the pure state, and used in inoculation experiments on animals. Divicine which occurs in akta in combination with a sugar as the glucoside vicine, produces on inoculation in guinea-pigs a characteristic and fatal disease. Akta, when fed to ducks, causes death. In monkeys it produces a very characteristic train of symptoms affecting the nervous and muscular systems. Though certain of the symptoms occurring in monkeys fed on diets containing akta have been described in cases of human lathyrism, it has not yet been proved that akta is the cause of lathyrism in man.

The Blood in Purpuric Small-pox (Kano Ikeda, M.D., *Journal of the American Medical Association*, June 13, 1925).—The purpuric type of small-pox is a definite clinical entity which presents a series of characteristic clinical manifestations wholly or partly unlike those of pustular small-pox. Its occurrence is rare. An unusually large number of cases of this type of small-pox was recorded in Minneapolis during the recent epidemic. Ten per cent. of the cases admitted to the Minneapolis General Hospital within a year were diagnosed as purpuric. Clinical diagnosis of purpuric small-pox occurs comparatively early, and is sufficiently specific to make its prompt and definite recognition possible. An attempt was successful in differentiating this type of the disease during its initial period from other forms of small-pox and also from other doubtful exanthems and acute infectious and toxic diseases by means of blood examinations.

The Fate of an Intravenously-Injected Dye (Brilliant Vital Red) with Special Reference to its use in Blood Volume Determination (H. P. Smith, *Bulletin of the Johns Hopkins Hospital*, May, 1925).—A study is made of the behaviour of brilliant vital red when introduced into the blood-stream. The relations of these findings to the physiology of phagocytosis and to the theory of blood-volume determination are discussed. It is found that the dye is slowly eliminated by the liver but not by the kidneys. Before being eliminated from the body much of the dye is taken up and stored by phagocytes. The phagocytes do not completely remove the dye from the plasma, because the phagocytic reaction is a matter of equilibrium between phagocytes and the dye-coloured plasma. The question of loss of dye from circulation and the possibility of incomplete admixture of the dye and plasma are discussed in relation to blood-volume determination. It is shown that dye passes in considerable amounts into the lymph, and that therefore the blood-volume figures also include part of the lymph and tissue fluids. This phenomenon doubtless explains in part the fact that the dye method gives figures which are larger than the carbon-monoxide or direct method of Welcker. Other reasons for this difference are discussed.

Abstract.

OXYURIS VERMICULARIS AS A CAUSATIVE FACTOR IN APPENDICITIS.[1]

By WILLIAM H. HARRIS, M.D., and DONOVAN C. BROWNE, M.D.

THE occurrence of *Oxyuris vermicularis* in the vermiform appendix of the human species has been frequently described in the literature. The description of parasites in this structure dates back to Fabricius, in 1634, and Santorini, in 1724. Metchnikoff was the first to lay stress on the relationship of intestinal parasites to appendicitis. Even though many reports, chiefly of single instances, have appeared from various centres, especially abroad, over a considerable period of time and form in their aggregate quite a voluminous literature, nevertheless, the rôle of the oxyuris as a causative factor of appendicitis has received little consideration. The reasons for such a condition are probably twofold: (1) The failure of proper clinical and pathological observations as to the extent of their occurrence in appendical involvements; (2) the difference of opinion existing relative to the pathogenic rôle played by these nematodes in such lesions.

[1] Abstracted from the *Journal of the American Medical Association*, February 28, 1925.

Unless the pathologist directs specific attention to the frequency of the occurrence of *O. vermicularis* and makes a careful examination of series of appendices with such a purpose in mind, hundreds of such structures will pass through the usual routine of pathologic examination, and such worms or their ova will not be observed. When, however, an appendix appears presenting a large number of oxyurids, they must of necessity be noted, even though the gross inspection has been of only a casual character. Such an occurrence alone, or the repetition of this happening, will often stimulate a more detailed observation of such structures, which will usually result in the finding of milder types of infection; that is, when lesser numbers of such organisms exist.

As observed in the series of instances here reported and as generally described by others, the oxyuris invasion has occurred especially in appendicitis clinically and pathologically of a subacute and chronic character. Excluding, therefore, the acute lesions which frequently require obligatory surgery, the question arises, if the casual relationship of oxyuris to the subacute and chronic types is finally accepted, whether the determination of the presence of these casual excitants classifies these particular cases into a medical rather than a surgical category.

The object of the present report is to record our observations of twenty-two appendices containing *O. vermicularis* in a series of 121 appendices presented in routine hospital laboratory examinations, together with the special consideration of the histopathology of those appendices in which *O. vermicularis* infection has been found.

Ætiologic Relationship.

The evidence of actual intramural invasion of the parasites into the mucosa and even submucosa of the appendix, with the destruction of tissue structure in their passage, indicates the capacity of the *Oxyuris* worm to produce pathologic changes of a degenerative character in the appendix. Like *Endamæba histolytica* or *Balantidium coli*, the manner in which the lesion is produced appears somewhat uncertain. Whether there occurs a mechanical destruction of structure or the production of a lytic substance capable of dissolving the cellular elements has not been determined. In either event, the parasites traverse from the lumen into the inner coats, and either *per se* or through the secondary bacterial invasions thus permitted, or by both methods bring about degenerative, and at times exudative changes. The latter exudate is usually representative of a chronic involvement, and thus produces the clinical manifestations that naturally emanate from such tissue changes. The fact that oxyuris worms may at times be found in the normal appendix does not negative the fact that they do actually produce disease of this structure either directly or conjointly.

Comment.

There exists a broad divergence of views relative to the ætiologic relationship of *O. vermicularis* to appendical lesions. There is also some variance in the character of cases presented. Frazier reports an acute case with the appendix filled with oxyurids, and regards the parasite as a predisposing cause occasioning blockage and favouring the invasion of *B. coli*. Innes and Campbell tabulate seventeen positive cases. They believe that the parasite produces the lesion, and conclude that there is probably a classic type of oxyuris appendicitis. Wood reports seven cases occurring in fifty-seven operations designating the condition as appendicopathia oxyurica. He considers that the oxyuris produces typical catarrhal lesions and at times nervous symptoms out of all proportion to the lesion. Romain states that the oxyuris enters into the appendix and causes disease through the inoculation of pathogenic microorganisms into the mucosa. Still states that 19 per cent. of healthy appendices of children harbour oxyurids. Cecil and Bulkley report a series of 129 unselected appendices of children, from 2 to 15 years of age, in which oxyurids were found in nineteen instances, or about 15 per cent. It is noteworthy that these authors observed the parasites only in acute instances. In fourteen, the histopathologic diagnosis was acute catarrhal appendicitis, and in three, acute gangrenous. In no instance was the appendix chronically inflamed. The change in the acute catarrhal types consisted especially of swelling of the follicles, with greater or lesser amounts of epithelial cell destruction. In some instances, however, they report cellular elements, such as eosinophils and lymphoid cells, which seem representative of subacute and chronic inflammation. These authors have reviewed the literature up to the time of their publication. Among other conclusions, they state that, "when oxyuris occurs in a diseased appendix, they are in most cases the existing cause of the pathological changes found." Since they consider the pathological condition present in the appendical lesions of children as acute, and as the greater number of instances reported in adults, including our own demonstrates a cellular and connective tissue response of a subacute and chronic variety, it is not unlikely that these infections may exist over a period of years and thus eventually demonstrate a histopathologic picture of a chronic type in later life. Like Cecil and Bulkley, we have observed the parasites in the lymphoid follicles creating no exudative response to the area, but with degenerative changes in evidence. At times exudative elements may be present about the nematode, but in these instances the presence of bacteria having a different chemitactic influence seems likely.

That the oxyuris produces pathologic changes in the vermiform seems indisputable. Their attachments to the mucosa, the hæmorrhagic ulcerations occurring at times about these attachments, and actual intramural invasion down to the musculature, and even penetrating this portion, with the destruction of tissue in their route of transit, form definite evidence of disease production. These changes usually provoke a clinical and pathological picture representative of a chronic and subacute form, as presented in such cases irrelevant of oxyuris invasion. That they may occur in the lumen of a normal appendix is also

evident, but that they remain in such a structure indefinitely without provoking pathologic changes is open to question, although it is conceivable that certain of these structures may not be vulnerable to the parasite. It is also probable that even in the absence of actual production of pathologic change, the oxyuris may at times give rise to appendicular colic. These later features, however, do not vitiate the fact that the oxyuris present in the appendix usually demonstrates a pathogenic rôle.

Whether or not the recognition of infection by the oxyuris in certain of the clinical cases of chronic appendicitis would save the patient from surgical procedure and place him within the power of medical therapeusis to heal seems still an open question.

In this connection Harnett reports a case wherein obscure symptoms existed with an eosinophilia of 10 per cent. Oxyuris was suspected, but the stool examinations were negative, even though santonin was administered. After operation, oxyuris was found in an inflamed appendix. Frazier reports an acutely inflamed appendix filled with oxyurids, which were crawling out of the open end. No worms could be found in the stool after operation, even though a course of calomel and santonin was given. Orton likewise reports an appendix somewhat thickened and slightly reddened, containing seventy-four adult female oxyurids and a number of males, in which the examination of stools after operation and following a laxative was negative for worms and ova. Wood does not consider that an anthelmintic could reach the worms and ova in the appendix. He considers that the danger of a delayed operation is greater than that of the operation itself. Armstrong believes that treatment directed against oxyuris infection may save the patient from operation.

A consideration of this phase of the subject appears to us to necessitate two subdivisions: First, in acutely inflamed appendices, even if oxyuris infection was known to exist, treatment with anthelmintics and purgatives would very clearly be contra-indicated. The lesion should be handled in a manner similar to acute appendicitis, due to any other cause. Second, in the obscure, low grade lesions with recurrent attacks, wherein the appendix is usually removed as a probable causative factor, it seems desirable that oxyuris infection should be primarily considered. In that event careful and repeated stool examinations should be made, and if found negative, similar examinations following the administration of an anthelmintic should be carried previous to operating. If infection of oxyuris is found present, specific treatment along this line seems in order. It appears possible, however, in the light of reported examples, that oxyuris infection may exist in the appendix and such examinations at times be negative.

In regard to the latter divisions, it must be appreciated that it may be possible to exterminate the oxyurids in the appendix, and especially those which have invaded the mural structures. Again, even though the parasites may be destroyed with treatment, the appendical lesion may possibly continue as the result of the pathological condition already set in motion and maintained because of concomitant bacterial factors that have secondarily invaded.

It appears logical that a proper opinion concerning the handling of the chronic cases, wherein oxyuris invasion of the appendix is considered, can be reached only after a series, with this specific purpose in mind, has been dealt with.

It seems remarkable that these parasites occur in the extent which they apparently do in the intestinal tract of even adult life. The frequency of the parasite in appendical lesions is also very striking. In France, Railliet reports fifty-eight infections in 119 cases of appendicitis, or 48 per cent., while Brumpt, in the same country, found oxyuris present in 3 per cent. of normal appendices and in 40 per cent. of all cases of appendicitis. In Germany, Hoepfl reports their presence in 19 per cent. of all cases of appendicitis. In England, Innes and Campbell report that 17 per cent. of inflamed appendices examined showed oxyuris infection. In this country, Cecil and Bulkley found 15 per cent., and we found approximately 17 per cent.

It is evident that insufficient attention has been given to the rôle played by *Oxyuris vermicularis* in the causation of appendicitis. This factor has been neglected by clinicians, surgeons, and pathologists. The oversight is especially attributable to the pathologist, for if a series of 100 appendices removed at operation for appendicitis are carefully studied for oxyuris invasion, the worms will most likely be found present in a considerable percentage of cases. Appendices, like tonsils and adenoids, when received in the laboratory, are usually given only a cursory gross examination and then sectioned for microscopic study. In this manner a great number of positive instances are not brought to light. Such an occurrence demonstrates the fact that it is of considerable importance to study the causation of the pathological condition of all structures sent to the laboratory, as well as the tissue changes produced by the process of disease.

Summary and Conclusions.

Infestation with *Oxyuris vermicularis* occurred in twenty-two appendices out of an uninterrupted sequence of 121 cases of operative appendicitis.

The study of the gross and histologic pathologic condition of the appendices containing the oxyuris demonstrates conclusively that these nematodes possess a definite pathogenic rôle in the causation of the appendical lesion.

The failure of recognition of the oxyuris as a factor in the production of appendicitis is due in general to the lack of detailed gross and microscopic study of the vermiform appendix.

It is important in all cases of chronic recurrent appendicitis to consider the likelihood of *Oxyuris vermicularis* as a causative factor.

Aside from the frequency of occurrence of the oxyuris in appendicitis, the widespread presence of these worms in the intestinal tract of adult life is not generally realized.

The observations on record of the frequent relationship of the oxyuris to appendicitis justify a more general and thorough study of this subject.

Current Literature.

The Indian Medical Gazette.
June, 1925.

A Note on the Disinfestation of Houses by Fumigation with Cresol (R. B. Lal and C. D. Tiwari).—These studies on the efficacy of fumigation with cresol were undertaken in August, 1924; the results were very favourable. Cresol fumigation, as ordinarily carried out, has no action on rats, but has a definite toxic action on rat fleas in muslin bags, free in the room, or on the bodies of the rats, but more than two ounces (quantity recommended by Colonel Lane) is required for ordinary sized rooms of 1,000 to 1,500 cubic feet capacity. Household furniture and rat runs afford effective protection to the fleas against the action of the vapour, even when the drug is used in large quantities. Fumigation with cresol tends to cause the fleas to leave their host. The toxic action of cresol vapour is more manifest at higher levels as compared with the floor level. Slightly better results are obtained by vapourising cresol on two heaps of smouldering cow-dung cakes instead of on one. The recommendations given to make the disinfection by cresol effective are: Remove all the furniture and sundries before disinfestation, and thoroughly expose them to the sun. Use ten ounces of cresol in an ordinary room of 1,000 cubic feet capacity. Preferably distribute the drug over two iron pans containing smouldering cow-dung cakes placed in different parts of the room. Some mechanical means should be arranged for preventing the vapour from directly rising up. Room should be carefully sealed before fumigation, and kept closed for four hours afterwards. Floor should be washed with phenyl lotion after the disinfestation is over, and rat runs should be fumigated with *neem*-cartridges and then closed.

Abdominal Tuberculosis in Indian Practice (E. W. C. Bradfield).—Cases of abdominal tuberculosis are not rare in India, as is shown by the records of the General Hospital, Madras. Of 205 cases admitted to hospital in 1924 for surgical forms of tuberculosis 95 were abdominal cases; this is a higher percentage than is found in the European general hospitals. The author believes that absence of bovine tuberculosis in the Madras Presidency influences the incidence and character of the disease in South India. Tuberculous diseases of bones and joints, though not so commonly seen as in European hospitals, pursue a much more intractable course and are less amenable to non-operative forms of treatment. The various types of tuberculous disease as met with in India are described and results of operations are given.

Yaws (Framboesia) in the Chin Hills (P. Bell).—Until the arrival of the author in the Chin Hills, 1923, many cases of yaws were being treated as syphilis. He clearly compares the two diseases clinically, and finds that a microscopical examination is unnecessary. The typical case is described as follows: Onset usually a small pimple at the margin of the anus, which bursts, spreads, and eventually involves the groin or private parts, some cases starting in the groin and on the labia majora. Some cases start with an ulcer as already described at the angle of the mouth. Two women stated that their breasts were affected first. No history of primary sore; sometimes whole families are affected. Males, females and children appear to be affected equally, though females mostly apply for treatment.

Report on a Visit to the Leper Island of Culion and on the Anti-Leprosy Work in the Philippine Islands (E. Muir).—From this interesting report it will be seen what valuable work has been carried on during the last nineteen years in the Philippine Islands with regards to leprosy. It was determined by the Americans in 1906, on their occupation of the Philippine Islands, to deport all bacteriologically positive lepers to Culion, an island about 200 miles to the S.W. of Manila, and since that year there has been a very considerable reduction in the prevalence of the disease. The author, who has had large experience of anti-leprosy work in India, compares conditions connected with leprosy in that country with corresponding conditions in the Philippines, and gives the methods to be adopted in both countries to bring about the entire disappearance of the disease.

Diabetes and Insulin Treatment in Bengal (Lal Mohan Ghosal).—Although at the present day much benefit is being derived from insulin in the treatment of diabetes, both in Europe and in America, the results with this product in Bengal appear to be very poor. It was thought that this might be due to the diabetes in Bengal not being due to pancreatic defect, and investigations were therefore carried out. The results were as follows: (*a*) With very marked pancreatic defect, even with a big tumour at the head of the pancreas, sugar was never detected in the urine in some cases. (*b*) Even with marked diabetes, pancreatic defect could not be found in some cases. Such patients are long lived, keeping good health throughout. None of them responded satisfactorily to insulin. (*c*) With pancreatic defect and glycosuria, the patients were always in bad health and there was evidence of rapid emaciation from the beginning; these are the cases that respond to insulin treatment. To obtain beneficial results from the use of insulin, cases of diabetes due to pancreatic deficiency should be selected; this may be done by using the following points as a guide: *Clinically*, the disease is of short duration and within a very short time the patient becomes very emaciated; the anæmia is very marked; the body fat is markedly reduced, leaving a skeleton-like appearance; dyspepsia is very troublesome; sleep at night is disturbed, sometimes there is no sleep the whole night; weakness is very marked; irritability of the temper is very prominent and there is general lethargy and lassitude. *Pathologically*, the pancreatic deficiency as shown by Cammidge's test is very marked.

Original Communications.

GONGYLONEMA.

By Louis W. Sambon, M.D.

Lecturer in the London School of Hygiene and Tropical Medicine.

In my first cancer paper, read before the Royal Society of Medicine, May 23, 1924, I explained how the peculiar topographical distribution of cancer in Romagna, the prevalence of the disease in the œsophagus and in the cardiac portion of the stomach, the constant presence of cockroaches, meal-beetles and cellar-beetles—all fosterers of the larval stages of *Gongylonema neoplasticum*—in the houses where cancer cases had occurred, led me to inquire whether gongylonema might not be a factor in the causation of certain neoplasms affecting the upper portion of the alimentary tract of man, as is well known to be the case in rats infested by this spiruroid worm.

I pointed out that already, in 1864, Professor Carlo Pane, of Naples, had described, under the name of *Filaria labialis*, a nematode found in the upper lip of a Neapolitan medical student, which, from the drawing of the worm accompanying his paper, I recognized to be a *Gongylonema*. I gave a list of the species of *Gongylonema* described to date, together with a short history of the genus and all available information concerning the cases of gongylonema infestation in man recently observed in the United States of America by Ward, Stiles and Ransom.

Since then considerable advance has been made in our knowledge of the genus *Gongylonema*. In the autumn of 1924, Dr. Baylis and I went to Northern Italy and we looked for *Gongylonema*, finding it in the cattle, sheep, goats and hogs of the Provinces of Trento, Bologna and Ravenna, where hitherto it had escaped notice. *Gongylonema* no doubt is distributed widely throughout Italy and neighbouring islands. It had been found by Professor Giulio Alessandrini, of Rome, in the sheep of the Roman Campagna and in cattle imported from the island of Sardinia.

A careful comparative study of the material brought back from Italy, and of other material kindly given or lent by Professor Henry, of the Ecole Nationale Vétérinaire d'Alfort, Mr. Frank Ware, of the Royal Veterinary College, Professor Johannes Fibiger, of Copenhagen, and Dr. Cesare Cappelli, of Bologna, enabled Dr. Baylis to invalidate certain names such as *G. scutatum* and *G. ransomi*, which, he considers, should be looked upon merely as synonyms of *G. pulchrum* Molin 1857. Already Professor A. Railliet, in 1892, had pointed out the great similarity between *G. scutatum* and *G. pulchrum*, but had cautiously reserved judgment until male specimens should be forthcoming. These were eventually found by Fayet at Tebessa in Algeria and sent to Professor Neumann, who, however, retained the two species, remarking that they were "*tout à fait voisines*," differing only slightly in size.

I am inclined to agree with Dr. Baylis as to the synonymy of *G. scutatum*, *G. ransomi* and *G. pulchrum*. The slight differences in body size, relative distance between certain parts of the body, acumination of posterior extremity, length of spicules, seem far too slender, far too variable to permit of specific distinction, but if constant in the same kind of host, they would indicate the establishment of "host-races." There can be no doubt that in parasites with wide zoological distribution, and especially in those whose life-cycle is spent in two alternating hosts—a vertebrate and an invertebrate brought into close association by peculiar biological conditions—the host environment may be more or less favourable and may determine certain adaptive modifications of size and shape in the parasite, just as variable œcological surroundings may cause colour and other variations in free-living species of wide geographical distribution.

In a paper on "The Hæmogregarines of Snakes," published in the *Transactions of the Pathological Society of London*, in 1907, I suggested for parasites the recognition of "host-varieties" or "host-races" corresponding to the so-called "geographical races" of free-living animals. When adaptation, to a new environment in the case of free-living animals, or to a new host in the case of parasites, becomes marked and constant then the differentiation acquires specific value, but the recognition of race has many advantages; it avoids a bewildering multiplicity of names and manifests the zoological distribution of the parasite, a matter of no little importance to the sanitarian in preventive work.

Often I had found considerable difficulty in writing up differential descriptions of certain hæmogregarines, leucocytozoa and other blood protozoa obtained from closely allied host-species, yet I was fully convinced of their specificness. My studies had taught me that hæmogregarines differ specifically in different host-species when the latter inhabit different zoological regions, and this specificness is supported by the far more easily determinable specific differences present in the several metazoan parasites simultaneously infesting these same host species. On the other hand, certain species of hæmogregarines, like certain species of metazoan parasites, may be found in a variety of hosts belonging not only to closely related species, but also to different genera or even families, provided the latter inhabit the same zoological region and are attacked by the same species of blood-sucking ecto-parasites.

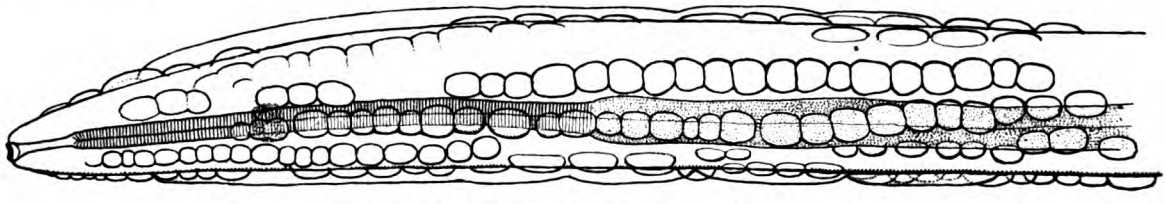
The specimens of *Gongylonema* with shorter spicule found in Algerian breeds of sheep and in the Indian buffalo can hardly be regarded as specifically different from those with longer spicule found in Italian breeds of sheep and in the Italian buffalo, originally imported from the East.

More difficult is the case of the rat gongylonema: *G. neoplasticum* of Fibiger and Ditlevsen, 1914. Here the difference of size is of little moment, but the difference in the length of the left spicule is so strikingly great that it seems to indicate specificness.

The first *Gongylonema* ever described—the type species of the genus—is *G. musculi*, a nematode found by Rudolph in the house mouse (*Mus mus-*

culus) " *circa ventriculum et in hepate*," and mentioned in his Synopsis (1819) without either description or figure.

Under the heading of " ? *Filaire de la Souris* " Dujardin (1845) states that a mature female specimen sent from Vienna to the Paris Museum, in 1816, measured 21·6 mm. in length by 0·154 mm. in thickness. It presented two lateral membranous alæ in the anterior portion and a tapering but blunt-ended posterior extremity. The elliptical ova measured 45 microns long by half that size in thickness. These characters, he thought, suggested a *Spiroptera*. Only two mice were found infested out of 1,274 examined.

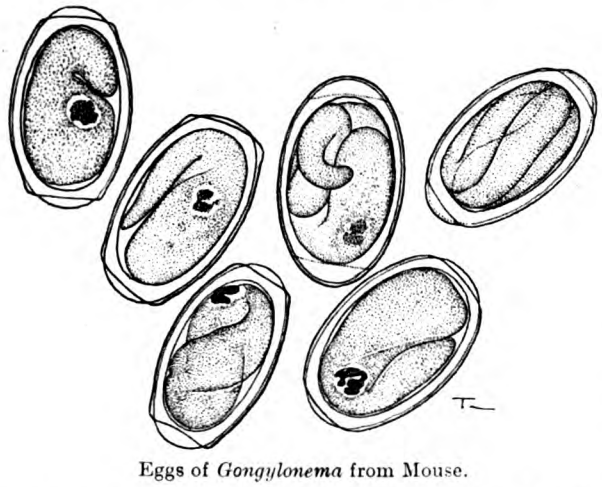


Anterior extremity of female *Gongylonema* from Mouse.

It was the Italian helminthologist, Dr. Raffaele Molin, who first proposed, in 1857, the genus *Gongylonema* for this parasite, which he described under the name of *G. minimum*. His description was based on several specimens, male and female, some free, others embedded in a piece of liver, from which they were extricated with difficulty.

Molin's description is as follows:

" *Gongylonema minimum*— *Os* orbiculare, inerme; *Corpus* capillare, inerme, flexuosum, breve; extremitas anterior maris attenuata, apice nudo, obtuso, bulbillis parvis, coarctatis; *extremitas anterior feminæ* attenuata, apice obtuso, bulbillis, magnis, discretis; *extremitas caudalis maris* inflexa, sensim attenuata, subtus excavata, fovea elliptica, magna, utrique limbis amplis, singulus quatuordecim papillis elevatis, decem ante, quatuor infra aperturam genitalem, vagina penis dipetala; *extremitas caudalis feminæ* subito attenuata, inflexa; *apertura ani* propo apicem caudalem; *apertura genitalis feminæ* in posteriore corporis parte, ab apertura ani remota— Longit. mar. 4″ (8·8 mm.); Longit. fem. 8″ (17·5 mm.)."



Eggs of *Gongylonema* from Mouse.

Molin adds that examining the sheath of the penis, at first sight it appears to be a ligulate sheath, but lightly compressing the caudal extremity of the male between two slides the said organ spreads apart into two branches like a forceps and, being released, at once returns to its former shape. The female's long oviduct was full of embryonated eggs.

Speaking of Dujardin's brief description of this gongylonema, Maurice C. Hall (1916) says, " Dujardin notes a specimen from Vienna as having two cervical alæ. This would suggest that he was not dealing with gongylonema." But the presence of cervical alæ more or less developed and often festooned is characteristic of gongylonema. On the other hand, the presence of this parasite in the liver, noted in the Vienna Museum catalogue and also reported by Molin, to my mind suggests confusion between *Gongylonema and Hepaticola*.

While studying gongylonema infestation of rats in Holland with a view of determining their rôle in the ætiology of gastric carcinoma, Dr. Wassink found this nematode in mice from an Amsterdam sugar refinery which was free from rats. He has kindly given me one of his mouse specimens, a mature female measuring 89 cm., which I cannot in any way distinguish from *G. neoplasticum*.

During the early stage of the formation of the embryo the eggs seem to consist of a thick barrel-shaped shell, containing the embryo enclosed in a vitelline membrane, which appears to protrude at the poles. The shell here, if formed at all, is very thin; later, however, by the time the embryo is fully formed, the shell at the poles becomes of almost equal thickness with the barrel-shaped portion, and the lines of demarcation become almost invisible (see fig.). Dr. Baylis has observed the same appearances in the ova of Alessandrini's human specimens and in those of the gongylonema of ruminants.

In 1914, Seurat described, under the name of *G brevispiculum*, a gongylonema found in the cardiac region of the stomach of the dwarf jerboa (*Lipodillus campestris*) in Algeria. His description and figures seem to agree with, and show only slight differences from, *G. neoplasticum*, and Hall says: "The principal and almost the only feature which distinguishes this species from *G. neoplasticum* is the presence of additional caudal papillæ in the male. The posterior extremity of *G. neoplasticum* is

figured with the bend to the left, which also occurs in *G. brevispiculum*. It appears quite possible that Fibiger and Ditlevsen (1914), in their excellent study of *G. neoplasticum*, may have overlooked some papillæ, and that a restudy will show that *G. brevispiculum* must be regarded as a synonym of *G. neoplasticum*. Until this point has been determined it will be safer to retain the two species, keeping in mind the possibility that they are identical. The fact that *G. neoplasticum* has been developed in such hosts as the rat, rabbit and guinea-pig, one of which is a notorious wanderer and cosmopolite, speaks for their identity in connection with their other features in common.

In the *Journal of Comparative Pathology and Therapeutics*, March, 1925, Dr. Baylis redescribed *G. verrucosum* (Giles, 1892), a gongylonema found by Lieut.-Col. G. M. Giles in the rumen of sheep in India, and later in an Indian ox (*Bos indicus*). He points out that Neumann's description of this species is erroneous, in that instead of the cuticular bosses being limited to the dorsal surface, as Neumann thought, they are confined to the left side of the body, ceasing abruptly at the mid-dorsal and mid-ventral lines, and that the single ala described by Neumann in his specimen is not dorsal but lateral, the ala of the right side being absent or, at all events, extremely reduced. Baylis points out that this kind of asymmetry is not unparalleled among parasitic nematodes. He cites the examples of *Streptopharagus* and *Arduenna* (genera probably not very distantly related to *Gongylonema*), where there is a single cervical ala on the left side. Among free-living nematodes even more striking examples of asymmetry may be found. In bunonema, for instance, there are one or two rows of large wart-like cuticular tubercles on the right side of the body only.

Dr. Baylis's description of *G. verrucosum* is based on female specimens collected by Mr. Frank Ware, F.R.C.V.S., in India. One measured 78 cm. in length and 0·45 mm. in thickness, another 88 cm. in length, 0·44 mm. in thickness. The ova measured 0·055 by 0·032.

G. spirale is the name given by Molin to a single male specimen of gongylonema found in the fallow deer (*Dama dama*). Neither his description nor his figures are of any value for diagnosis. *G. spirale* is probably a synonym of *G. scutatum*.

The same may be said of *G. filiforme* Molin 1857, found by Bremser beneath the tongue of the magot or Barbary ape (*Macacus inuus*). Neumann considered it "*très voisin de G. scutatum.*"

Rudolphi (synopsis 1819) mentions, under the name of *Spiroptera ursi*, certain nematodes twice found in the œsophagus of the brown bear (*Ursus arctos*) at Vienna. Dujardin (1845) states that they measured from 27 to 43 mm., were very slender, narrower anteriorly, the anterior extremity small with mouth orbicular, the posterior end (male ?) depressed, slightly blunt, fringed by a membrane which "*dans un seul individu, était beaucoup plus large.*"

Molin (1860) describes this species under the name of *G. contortum*.

In the *Journal of Tropical Medicine* (February 2, 1925), in a note following the publication of my Paris lecture on cancer, I stated that Prof Giulio Alessandrini, of Rome, had briefly reported, in 1914, a case of gongylonema infection in a young woman of Saracinesca, near Rome. Six worms were present, occupying sinuous galleries at the base of the tongue and about the frenum linguæ. Alessandrini suggested the name of *G. subtile* for this parasite, which he considered to be near *G. pulchrum*, but differing from it in being longer, more slender, the studded anterior portion more extended and the eggs smaller and more elongate.

A few weeks ago Prof. Alessandrini came to London to attend the Conference on sleeping-sickness and brought with him two of the three gongylonemas he had been able to obtain from the Saracinesca case. These worms differ in no way from specimens of *G. scutatum*, which are very common in the sheep of the Roman Campagna. Dr. Baylis has examined them very carefully and describes them fully in his paper.

I owe to my friend Prof. Alessandrini the following notes on his interesting case:—

The patient, I. O., a girl of eighteen years of age, had spent the first eight years of her life at Saracinesca, a hill village by the river Aniene, between Tivoli and Mandela; thence she had moved to the neighbouring village of Sambuci for about six years, then back to Saracinesca for two years, then to Tivoli for one year, and finally to Rome in March, 1913. On August 1, 1912, after a sojourn of ten months in Tivoli, the girl felt something like a hair in her mouth and drew out a worm which she threw away. A second worm she drew out on October 2, 1912, whilst at Saracinesca; a third at Tivoli on November 3, 1912, which was preserved by Dr. Allegri, of Tivoli, who had been consulted. The fourth worm was extracted also at Tivoli, but thrown away, the fifth was drawn out in Rome on April 5, 1913, and the sixth also in Rome on July 14, 1913. The last two worms were collected by Dr. Carrega, who gave them to Prof. Alessandrini for determination. The worms occupied sinuous galleries beneath the epithelium of the buccal mucosa, one at the base of the tongue, the others about the frenulum. Whenever the parasites protruded from their galleries, the patient felt the unpleasant sensation of having something like a hair in her mouth and endeavoured to draw it out, but the worm at once made resistance and usually, slipping through her fingers, withdrew into its gallery to protrude again later.

The patient was otherwise perfectly healthy, her menses had appeared at the age of 16½, and she had been regular until January, 1913, then irregular. She had suffered from eclampsia in her childhood. The mother had died of a tumour. Her father lived and was healthy, she had a brother and a sister both in good health.

During a short trip to Holland last spring, Dr. Bonne, Director of Laboratories in the Dutch Cancer Institute, kindly informed Dr. Reeser, Superintendent of the Amsterdam Municipal Slaughter House, that I should like to visit the

abattoir and possibly look for the presence of *Gongylonema* in Dutch breeds of cattle, sheep and hogs. When, on April 24, I called on Dr. Reeser, he informed me that Dr. Veenstra had opened up a large number of gullets of cattle and found the parasite in one. This was the first time that gongylonema was looked for and found in the land of the beautiful black and white cattle of Friesland, which are believed to be the direct descendants of the ancient Aurochs. Together with Drs. Reeser, Bonne and Veenstra, I examined many other gullets of cattle, sheep and hogs, but with negative result. At the Harlingen and Leeuwarden slaughter houses, with the aid of the local veterinarians, Dr. Bonne and I examined the œsophagus of about sixty sheep, but there again the result was negative. In one of the sheep examined there was the most intense infestation of sarcosporidia I had ever seen.

The gongylonemas found at the Amsterdam abattoir were typical specimens of *G. scutatum;* they numbered about twenty in the same gullet, males and females.

The distribution of *G. scutatum* seems to be almost as wide as that of its cattle hosts. It has been reported from North and South America, from many parts of Europe and Asia, from Africa and Australia. *G. neoplasticum* has a distribution as wide if not wider. Quite recently S. Yokogawa has described it from Formosa under the name of *G. neoplasticum var. orientale*, and as giving rise to a cancroid growth in rats.

SOME NOTES ON NEMATODE PARASITES FOUND BY Dr. WASSINK IN RATS AND MICE.

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In an interesting paper by W. F. Wassink (1916), the observations previously made by Fibiger and Ditlevsen on the *Gongylonema* of rats have been confirmed and extended. Out of 625 brown rats caught in Amsterdam, none showed evidence of the presence of *Gongylonema*, but ninety-nine were found to harbour a worm in the stomach, which is referred to as a *Trichosoma* (i.e., *Capillaria*), and probably the same species as that observed by Fibiger (1913) in some of his rats in Denmark.

On the other hand, out of a further 625 rats caught in ships lying in Dutch ports, which had made voyages either to South America or the East Indies, five (all believed to be of South American origin) were found to be infected with *Gongylonema*. In addition to these, the stomachs of forty rats (*Rattus norvegicus* and *R. rattus*) were obtained from Paramaribo, Surinam, and sixteen of these contained *Gongylonema*.

Cockroaches (*Blatta orientalis* and *Blattella germanica*) obtained from several localities in Amsterdam, including a bakery and one sugar refinery, were also examined, and were found free from the larvæ of *Gongylonema*. In another sugar refinery, however, about one in every seven cockroaches (*B. orientalis* and *Periplaneta americana*) was found to contain *Gongylonema* larvæ. No rats, curiously enough, were known to occur in this refinery, but on obtaining and examining ten mice from the premises, Wassink discovered *Gongylonema* in six of them. By feeding rats with some of the cockroaches, the worm was shown to be capable also of infecting rats, and was determined as *G. neoplasticum*.

Specimens of *P. americana* obtained from Surinam, from the same locality as the infected rats already mentioned, were found to contain larvæ of *Gongylonema*. It is not stated whether larvæ were present in cockroaches from the ships coming from South America, but they were not found in those from ships coming from the East Indies.

These observations, as Wassink says, seem to lend support to the view expressed by Fibiger that the *Gongylonema* of rats has been introduced into European sugar refineries in cockroaches imported with raw sugar from the West Indies or America.

During a recent visit to Holland, Dr. Sambon was able to obtain, through the kindness of Dr. Wassink and of Dr. C. Bonne, the loan of specimens of the worms referred to in the former's paper, some of them being part of the actual material studied by Wassink. These specimens Dr. Sambon very kindly handed over to the writer for examination, and a few brief notes on them may be of some interest.

(1) *Hepaticola hepatica* (Bancroft, 1893). — The worms referred to as *Trichosoma* unquestionably belong to the same species as those obtained by Dr. Sambon and the present writer in Italy, and, as mentioned in an earlier paper (Baylis, 1925), determined as *Hepaticola hepatica*. Although this worm has usually been observed in the liver, it evidently not infrequently takes up a position in the pavement-epithelium of the anterior portion of the stomach, where its galleries contain masses of eggs like those found in the spaces excavated by the worms beneath the capsule of the liver.

(2) *Gongylonema* from rats and mice.—The material available consisted of mounted microscopic preparations of some of Dr. Wassink's specimens from rats (locality not specified) and one from a mouse, also a considerable number of spirit specimens obtained later by Dr. Bonne from rats from Paramaribo, Surinam.

Among the mounted specimens from rats there was unfortunately only one male. There were three female specimens, all fragmentary. The male specimen was obviously immature, the bosses at the anterior end being as yet quite undeveloped, and the accessory piece not yet chitinized. Two of the females, besides having lost their anterior ends, were mounted in Canada balsam, an unsatisfactory medium for most nematodes, and it was therefore thought inadvisable to pay any special attention to their measurements. Measurements of the single male, and of the anterior portion of one female, both mounted in a glycerine medium, are given in the table below.

The single specimen from a mouse was a mature female, whose measurements, so far as they could be obtained from the mounted worm, are also tabulated.

MEASUREMENTS (IN MM.) OF DR. WASSINK'S SPECIMENS OF *Gongylonema*.

Host	Rat		Mouse
	♂	♀	♀
Length	12·3	—	89·0
Maximum thickness	0·25*	—	0·36
Anterior end to end of œsophagus	2·8	4·8	6·0
,, ,, end of muscular portion of œsophagus	0·47	0·55	0·9
,, ,, cervical papillæ	—	0·143	0·15
,, ,, commencement of alæ	—	0·185	0·213
,, ,, nerve-ring	0·2	0·22	0·3
,, ,, excretory pore	—	0·45	—
Length of tail	0·17	—	0·3
Diameter of buccal rim	—	0·025	—
Length of pharynx	0·065	0·055	0·07
Cuticular striations, distance apart	0·005	0·01	0·02
Length of spicules, left	0·65	—	—
,, ,, right	0·1	—	8·4
Vulva from posterior end	—	—	—
Ova, length	—	+	0·0625-0·065
,, breadth	—	+	0·0375-0·04

* Specimen somewhat flattened under cover-glass pressure.

† In the portion of uterus available in this specimen, none of the eggs contained fully-formed embryos.

They show no departure from the usual dimensions of *Gongylonema neoplasticum*, except in the unusually long distance between the vulva and the posterior extremity. The position of the vulva, however, is subject to considerable variation in *Gongylonema*, and cannot be regarded as of specific importance.

The material from Paramaribo was obtained from eight different rats, and included a number of males, sixteen of which were measured. The lengths of the left spicules of these sixteen specimens varied between 0·3 and 0·64 mm., and the total lengths of the worms between 7·1 and 12·5 mm. Their other dimensions, and those of the females measured, fall between the extremes already observed for *G. neoplasticum*, as tabulated in the writer's earlier paper (1925), and further description is unnecessary. Some of the male worms were obviously immature, as shown by the imperfect development or absence of the cuticular bosses at the anterior end, and the feeble degree of chitinization of the accessory piece. It is significant, however, that none of the sixteen specimens showed a left spicule of more than 0·64 mm. in length. In the specimens from rats hitherto measured, the length of this organ has never been found to exceed 0·67 mm., a fact which, in spite of general agreement in morphological features (see the writer's earlier paper), makes it difficult to assume that the *G. neoplasticum* of rodents is specifically identical with the *G. pulchrum* of other hosts. Experimental evidence seems to be required before it can be decided whether or not we are here dealing with more than one species or race.

It may be mentioned here that while in Holland Dr. Sambon had the good fortune to obtain, at the slaughter house at Amsterdam, the œsophagus of an ox containing several specimens of *Gongylonema*. These have also been examined by the writer, and have been found to differ in no respect from the examples of *G. pulchrum* (= *G. scutatum*) already obtained from Italy and elsewhere.

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OBSERVATIONS ON THE CULTURAL AND BIOCHEMICAL CHARACTERS OF *MONILIA CASTELLANII* (*CRYPTOCOCCUS CASTELLANII*) AND *MONILIA MACROGLOSSIÆ* (*CRYPTOCOCCUS MACROGLOSSIÆ*).

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Monilia castellanii (*Cryptococcus castellanii*).—Castellani has made the observation that certain cases which clinically have all the appearances of ordinary severe furunculosis are in reality caused by yeast-like fungi, the staphylococcus playing only a secondary rôle. For the condition he suggested the name of "Furunculosis cryptococcica"; and as it principally affects the scalp, causing a purulent folliculitis, he also used the term "*folliculitis decalvans cryptococcica*." He has observed five cases: three contracted the affection in England and two in India. From the three English cases he isolated a yeast-like organism, identical in all the three cases, of which he has given a full description. He has, however, not named the organism, and I would suggest that the fungus be called *Monilia castellanii*. I will give later the reasons why I consider the organism to belong to the genus *Monilia* rather than to the genus *Cryptococcus*.

As regards the cultural characters of this organism, my work confirms the investigations carried out by Castellani. It is a yeast-like organism, Gram-positive, not acid-fast. It grows well on all ordinary laboratory media and very abundantly on glucose agar. On this medium the growth is at first white, but after a few days a peculiar, well marked, yellowish-brownish pigmentation with occasionally a reddish tinge appears. Gelatine and serum are not

TABLE I.

Fungus	*Monilia* (*Cryptococcus*) *castellanii*	*Monilia* (*Cryptococcus*) *macroglossiæ*
Motility ...	O	O
Gram ...	+	+
Litmus milk — 3rd day	O	O
Litmus milk — 6th ,,	O	O
Litmus milk — 12th ,,	O	O
Litmus milk — 16th ,,	O	O
Glucose ... — 3rd ,,	AG	O
Glucose ... — 6th ,,	AG	O
Glucose ... — 12th ,,	AG	O
Glucose ... — 16th ,,	AG	O or Avs
Levulose — 3rd ,,	AG	O
Levulose — 6th ,,	AG	O
Levulose — 12th ,,	AG	O
Levulose — 16th ,,	AG	O or Avs
Maltose ... — 3rd ,,	O	O
Maltose ... — 6th ,,	O	O
Maltose ... — 12th ,,	O	O
Maltose ... — 16th ,,	O	O
Galactose — 3rd ,,	O	O
Galactose — 6th ,,	O	O
Galactose — 12th ,,	O or A	O
Galactose — 16th ,,	O or A	O or As
Saccharose — 3rd ,,	O	O
Saccharose — 6th ,,	O	O
Saccharose — 12th ,,	O	O
Saccharose — 16th	O	O
Mannitol — 3rd ,,	O	O
Mannitol — 6th ,,	O	O
Mannitol — 12th ,,	O	O
Mannitol — 16th ,,	O	O
Dulcitol — 3rd ,,	O	O
Dulcitol — 6th ,,	O	O
Dulcitol — 12th ,,	O	O
Dulcitol — 16th ,,	O	O
Salicin ... — 3rd ,,	O	O
Salicin ... — 6th ,,	O	O
Salicin ... — 12th ,,	O	O
Salicin ... — 16th ,,	O	O
Inosite ... — 3rd ,,	O	O
Inosite ... — 6th ,,	O	O
Inosite ... — 12th ,,	O	O
Inosite ... — 16th ,,	O	O
Dextrin ... — 3rd ,,	O	O
Dextrin ... — 6th ,,	O	O
Dextrin ... — 12th ,,	O	O
Dextrin ... — 16th ,,	O	O
Inulin ... — 3rd ,,	O	O
Inulin ... — 6th ,,	O	O
Inulin ... — 12th ,,	O	O
Inulin ... — 16th ,,	O	O
Sorbite ... — 3rd ,,	O	O
Sorbite ... — 6th ,,	O	O
Sorbite ... — 12th ,,	O	O
Sorbite ... — 16th ,,	O	O
Adonite ... — 3rd ,,	O	O
Adonite ... — 6th ,,	O	O
Adonite ... — 12th ,,	O	O
Adonite ... — 16th ,,	O	O
Arabinose — 3rd ,,	O	O
Arabinose — 6th ,,	O	O
Arabinose — 12th ,,	O	O
Arabinose — 16th ,,	O	O
Raffinose — 3rd ,,	O	O
Raffinose — 6th ,,	O	O
Raffinose — 12th ,,	O	O
Raffinose — 16th ,,	O	O
Isodulcite — 3rd ,,	O	O
Isodulcite — 6th ,,	O	O
Isodulcite — 12th ,,	O	O
Isodulcite — 16th ,,	O	O
Erythrite — 3rd ,,	O	O
Erythrite — 6th ,,	O	O
Erythrite — 12th ,,	O	O
Erythrite — 16th ,,	O	O
Remarks	Growth on glucose-agar is white at first, then yellowish-brownish. No discoloration or only very slight in lead-agar	Growth on glucose-agar is permanently white. Usually well marked dark or black discoloration in lead-agar

liquefied. Litmus milk may be rendered slightly acid, but is not clotted. As regards sugar reactions, the fungus when recently isolated may not produce gas in any sugar, although it generally produces a slight acidity in glucose; after several transplantations, however, it usually ferments glucose and levulose with production of acid and gas. When grown on lead-agar no black discoloration of the medium is observed, or only a very slight one.

Botanical position of the fungus.—I follow Castellani's and Chalmer's classification of yeast-like fungi. The fungus is yeast-like, but no ascus formations are seen even in very old cultures. It should therefore be placed in the division of yeast-like fungi with no ascospores. This division contains the genera *Cryptococcus* Kützing 1833, *Torula* Persoon 1801, *Mycoderma* Persoon 1822, *Monilia* Persoon 1879, *Pityrosporum* Sabouraud 1895, which may be differentiated as follows:—

(A) *Mycelium absent*:—

(i) Vegetative cells, elongated, thick membrane, with bubbles of gas—*Mycoderma*.

(ii) Vegetative cells, roundish or oval:—

(*a*) *Several buds at a time*, each cell contains large globule of fat, non-pathogenic, no fermentation of sugars, thick membrane with no gas bubbles, often pigment-producing—*Torula*.

(*b*) *One bud only*, no thick pellicle on fluid sugar media, presence or absence of fermentation—*Cryptococcus*.

(*c*) *Not cultivated*, cells never show a double contour—*Pityrosporum*.

(B) *Mycelium present—Monilia*.

The yeast-like fungus isolated by Castellani in cases of pseudo-furunculosis generally appears under the shape of oval or roundish cells, some of which are budding; Castellani was, therefore, justified in placing it at first in the genus *Cryptococcus*, especially as the fungus at first had very little or no fermentative action on glucose. When grown, however, in certain liquid media a small amount of mycelium develops, and, moreover, the fungus after a time acquires a fermentative action on glucose and levulose. I am inclined, therefore, to place the fungus in the genus *Monilia*.

The genus *Monilia*, as understood to-day by medical mycologists, does not correspond to the original genus *Monilia* as defined by Persoon "Stipitata aut effusa byssoidea. Fila moniliformis articulata." The term Monilia has been greatly extended, especially by Pinoy, Castellani, and others, to cover every yeast-like organism having no ascospores and showing presence of mycelium, even in very small amount, in certain media.

Monilia macroglossiæ (Castellani).—From certain cases of blastomycetic macroglossia, Castellani has isolated from the deep parts of the lesions a yeast-like fungus which he called *Cryptococcus macroglossiæ* (*Monilia macroglossiæ*). The investigation I have carried out on this fungus has confirmed in a general way Castellani's description. The fungus is a yeast-like organism which is Gram-positive and not acid-fast. It grows well on all ordinary laboratory media, best on glucose-agar. Gelatine and serum are not liquefied. In litmus milk there is no change. When grown on lead-agar a well-marked black or dark discoloration, as first noted by Castellani, is generally produced. The fungus, even when it has been transplanted many times, does not appear to acquire any fermentative action on glucose or other sugars.

Botanical position of the fungus.—As mycelium though in small amount, is often present when the fungus is grown in certain liquid media, I consider the fungus to be a monilia rather than a cryptococcus

		Colour of growth on glucose agar	Litmus Milk	Serum	Gelatine	Erythrite	Inositol	Amygdalin	Salicin	Inosite	Glycerine	Starch	Sorbite	Inulin	Adonite	Arabinose	Raffinose	Dextrin	Inulin	Mannite	Lactose	Saccharose	Galactose	Maltose	Levulose	Glucose
Monilia zeylanica Castellani	...	Yellowish	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Monilia zeylanoides Castellani	...	White	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Monilia (cryptococcus) macroglossiæ Castellani	...	White	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Monilia balcanica Castellani...	...	White	C	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia parabalcanica Castellani	...	Wh to	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia krusei Castellani ...	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia parakrusei Castellani	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia (cryptococcus) Castellanii Re	...	Yellowish or brownish-reddish	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia pinoyi Castellani ...	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Monilia nabarroi Castellani ...	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia metalondinensis Castellani...	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia pseudolondinensis Castellani	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia alba Castellani ...	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia pseudolondinoides Castellani	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia africana Macfie, 1921	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia albicans, Robin ...	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia tropicalis Castellani...	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia metatropicalis Castellani	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia rhoi Castellani ...	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia guillermondi Castellani	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia pseudoguillermondi Castellani	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia macedoniensis Castellani	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia macedoniensoides Castellani	...	White	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G
Monilia chalmersi Castellani	...	Dark brown	G	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G	G	G	G

C = clot; G = gas; S = slight; O = negative result, viz., non-production of gas in sugar media, or of clot in milk, or of liquefaction in serum and gelatine; + = positive result.

as at first believed by Castellani. As it does not produce gas in any sugar it belongs to the *Monilia zeylanica* group. It differs from *Monilia zeylanica* in the cultures being white, and from *Monilia zeylanoides* in producing a well defined dark or black discoloration in lead-agar.

Conclusion.—My investigation on the cultural and biochemical characters of *Monilia* (*Cryptococcus*) *castellanii* and *Monilia* (*Cryptococcus*) *macroglossiæ* confirms the description of these two fungi by Castellani. As regards their botanical position, I am of the opinion that as in certain media mycelium is present although in very small amount, both fungi should be placed in the genus *Monilia sensu lato*, in the meaning of Pinoy and other mycologists, rather than in the genus *Cryptococcus*, as originally suggested by Castellani.

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A Survey of the Turpentine Industry for Possible Larvicidal Instances (M. E. Barnes, *American Journal of Hygiene*, May, 1925).—Among the raw materials, products and by-products of the turpentine industry which were studied, larvicidal properties in sufficient strength to merit further investigation were found only in turpentine and in pine oil. Turpentine, after standing for some time, was found to be effective against both anopheles and culicine larvæ. It is too expensive, however, to be employed in anti-mosquito work. Pine oil was found to be effective against both anopheles and culicine larvæ and was further studied. The results of this study are incorporated in a separate paper, "The toxic action of oil films upon mosquito larvæ, with particular reference to pine-oil films."

Two New Cases of Human Creeping Disease (*Gnathostomiasis*) *in China, with a Note on the Infection in Reservoir Hosts in the China Area* (K. Morishita and E. Carroll Faust, *Journal of Parasitology*, March, 1925).—Five indisputable cases of human gnathostomiasis have hitherto been reported. Four of these are referable to *Gnathostoma spinigerum* and one to *G. hispidum*. Two new cases of human gnathostomiasis from China are added. The new cases deal with very young forms, one of which caused a typical "creeping disease." The other may have also caused the same disease. Four cases of gnathostomiasis interna are recorded from dogs and cats in China. Three of these were found in cats and one in a dog. One cat was autopsied in Pekin. The other infections occurred in the Hankow area.

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FREQUENCY OF INTESTINAL FLAGELLATES IN TEMPERATE CLIMATES.

NOT very long ago the belief was general that intestinal flagellates were common in tropical and sub-tropical countries, but rare in the temperate zone. Observations carried out in recent years, especially during and after the Great War, 1914-1918, have clearly shown that the distribution of intestinal flagellates is cosmopolitan, although it may be said in a general way that the incidence of these parasites is greater the nearer one approaches the Equator.

Flagellates are of common occurrence in every country of Europe and America. Le Noir and Deshiens in a very interesting paper published recently in the *Archives des Maladies de l'Appareil digestif*, give the results of an investigation they have carried out in a thousand patients in the out-patients department of one of the Paris hospitals. They have found that 17 per cent. of the patients harboured *Chilomastix mesnili* and *Trichomonas intestinalis*; *Lamblia intestinalis* was also fairly often met with.

Several authorities have recently again raised the question of the pathogenicity of flagellates; and the suggestion has been made that they may be responsible for certain cases of obscure disorder of the digestive canal; cases of so-called flagellate diarrhœa have been placed on record by many observers, but some authorities are rather sceptical about the flagellates being the real causative agents of the condition.

Castellani and Chalmers, some years ago, came to the conclusion that flagellates when present in small numbers are probably harmless, but when present in huge numbers, as is at times the case, they are capable of causing intestinal disturbances.

The eradication of intestinal flagellates by means of drugs is most difficult. Methylene blue, first introduced by Castellani, seems to be useful in the case of trichomonas and chilomastix infections, but has no action on lamblia. Thymol, B. naphthol, turpentine, iodoform have been recommended. Recently stovarsol has been used, but the results have not been constantly favourable.

YERBA MATÉ.

Yerba maté is the usual South American term given to the infusion prepared from the leaves of *Ilex paraguayensis*, St. Hilaire. The leaves are previously slightly scorched, then broken down and subjected to strong pressure. A handful of this pressed foliage is infused in a small vegetable gourd shell called a *maté*, from which it is sucked hot or cold through a reed or metal tube about 10 in. long which is called the *bombilla*. At other times a small spouted vessel is used, the spout being perforated at its lower side with small holes which allow the fluid to escape while retaining the leaves. The infusion is passed round and several people drink it, using the same *bombilla* and this habit is considered by many observers to be an important means of spreading espundia, yaws, syphilis and angiofibroma contagiosum tropicum.

It is estimated that more than eighteen millions of people in South America drink maté as tea. There are several varieties of yerba maté; the best is the original Paraguayan. The Brazilian variety known also as *herva matte* is rather bitter and not so pleasing to the palate; it is prepared by using the crushed and fermented leaves of *Ilex gongonha* Martius and *Ilex theœzans* Martius. Maté is con-

sidered in the Argentine, Paraguay and Brazil to be a health-giving drink; to ward off rheumatism and to produce an exhilarating and at the same time soothing effect on the nerves. It is also considered to have very sustaining properties. The "gauchos" for instance, who work the whole day on the Argentine ranches rounding up cattle, do this often on nothing more than a cup of maté in the morning and another at midday. It is the principal beverage of all the rural working classes in the Argentine, in Paraguay and Brazil. Attempts have been made recently to popularize maté drinking in North America and Europe but so far with very little success. Although maté is a good beverage and containing very little tannin would suit meat eaters, yet it is very unlikely that it will ever supplant, even partially, tea drinking in these countries.

Annotations.

Significance of a Hæmoptysic onset in Tuberculosis (F. H. Trudeau, M.D., *Journal of the American Medical Association*, June 13, 1925).—In a study of 245 patients entering the Trudeau Sanatorium between the years 1911 and 1922, and having hæmoptysis as the first symptom, it was found only 10, or 4 per cent., failed to show other evidence of tuberculosis. One hundred and forty-nine, or 60·81 per cent., had a positive sputum, either while in the sanatorium or prior to entrance. One hundred and seventy-one, or 69·83 per cent., had definite parenchymatous Roentgen-ray findings. In 196, or 80 per cent., persistent râles were heard in the upper portion of the chest. Ten, or 4·08 per cent., had had at some time pleurisy with effusion, or developed this condition while in the institution. The prognosis in this type of case is no better or worse than in any other mode of onset of this disease.

Complaints of Patients under Antileprosy Treatment—III. Comparison of Creosoted and Non-Creosoted Chaulmoogra Ethyl Ester Preparations (H. W. Wade, *Philippine Journal of Science*, January, 1925).—Duration of the disease, which averages 8·3 years in the cases under treatment, seems to have little influence on the total incidence of complaints in lepers under treatment, though certain types of complaint tend to increase and others to decrease. There is indication that, in the interest of intensive treatment, it is better to give higher dosage than to depend upon regular injections, at least in a large colony. Plain chaulmoogra ethyl esters are again shown to be decidedly the least favourable of the preparations used as regards treatment factors, frequency of total complaints, and most of the complaint types. The addition of creosote (10 per cent. has been used here) to plain chaulmoogra ethyl ester reduces the local irritation to almost, though not quite, the same degree as does 0·5 per cent. iodine, and permits increased medication. The simple iodized drug is somewhat, though not markedly, better than the simple creosoted as regards amount of medication and frequencies of complaints. Which is to be preferred will depend on a comparison of the therapeutic effects. The combination of creosote and iodine has no distinct advantage and has certain disadvantages because of which its use is not justified unless it has an unexpected therapeutic superiority. The only noteworthy drawback for the creosoted preparations is an apparently greater tendency to cause respiratory-tract irritation. However, this indication may be due to a possible selection of cases showing evidence of pulmonary disease for treatment by these preparations, and must be controlled by further observation.

An Institutional Outbreak of Scarlet Fever. The Skin Test for Susceptibility (Alex. F. Robertson. Junr., M.D., *Journal of the American Medical Association*, June 13, 1925).—The use of the skin test for susceptibility to scarlet fever is of value in the management of an institutional outbreak Negative reactors occasionally develop scarlet fever. The immunity resulting from an attack of scarlet fever usually renders the skin test negative. Pseudo-negative reactors should be re-tested before final tabulation of results.

The Viability of Typhoid Bacilli in Shell Oysters (Edwin O. Jordan. *Journal of the American Medical Association*, May 9, 1923).—Shell oysters artificially contaminated with typhoid bacilli by floating for one hour in sea water to which typhoid bacilli had been added and then placed at ice-box temperature (from 5° to 8° C.) were found to contain living typhoid bacilli for as long as twenty-four days. There was no evidence of multiplication, and after the first few days a diminution in numbers was plainly apparent. Of the three strains used, one was found to survive to the twenty-first day, one to the twenty-second, and one to the twenty-fourth.

Therapeutic Action of Potassium Iodide in Experimental Syphilis of the Rabbit (Louise Pearce, *Archives of Dermatology and Syphilology*, July, 1925).—The regular administration at bi-weekly and weekly intervals of small doses of potassium iodide (0·006 and 0·003 grm. per kilogram) to rabbits infected with *Spirochæta pallida* has resulted in modifying the severity and in shortening the duration of the experimental disease as measured both by the character of the primary orchitis and of the general manifestations. The disease which developed in the rabbits treated with iodide resembles in many ways that of normal rabbits of relatively high resistance in which few or no secondary lesions arise. It is suggested that the therapeutic action of potassium iodide in experimental syphilis of the rabbit is associated with a stimulation or a reinforcement of the host's mechanism of reaction or defence.

Cosmetics (Hiram E. Miller, M.D., and Laurence R. Taussig, M.D., *Journal of the American Medical Association*, June 27, 1925).—Sufficient emphasis has not been placed on the usual components of cosmetics and the dermatoses that they may provoke. Many of the so-called eczemas in women, if carefully investigated, will be found to be cases of dermatitis venenata due to cosmetics. The aniline dye used as colouring matter in the bizarre tints of face powder, rouge and lip stick may cause a definite dermatitis. Hair dyes containing the vegetable pigments are seldom harmful, while those containing the minerals or aniline products may cause skin eruptions or general ill-health. The attempted removal of wrinkles by applying phenol to large areas of the skin surface may cause considerable facial deformity and even death. A dermatitis on the sides of the neck in women may be due to irritation from recently applied liquid nail polish that comes in contact with the neck when the patient sleeps with the hands under the face. Legislation should be enacted prohibiting the use of the aniline dyes in the manufacture of cosmetics, and the application of phenol for the removal of wrinkles by unlicensed charlatans and beauty specialists.

Mercurochrome-220 Soluble in Genito-urinary Diseases (F. H. Redewill, M.D., and James E. Potter, M.D.), *Journal of the American Medical Association*, June 20, 1925).—Mercurochrome-220 soluble is considered one of the most important new remedies for use in intravenous medication. This drug is excreted in large quantities by the kidneys and also secreted through the prostate, seminal vesicles and other glands of the genito-urinary tract. Thus this dye comes in direct contact with the inflamed areas of this tract, by way of the urine and blood-stream. To obtain the best results, this remedy should be given in small doses to avoid a too early saturation. Patients who respond best to intravenous mercurochrome injections have mild reactions. Acute rheumatism, synovitis, myalgia, neuritis, arthritis, and other manifestations as a result of absorption from the prostate and seminal vesicles as sites of focal infection have cleared up on the intravenous administration of mercurochrome. A large number of acute gonorrhœal urethritis, epididymitis, prostatitis and seminal vesiculitis cases cleared up rapidly with this medication. The drug should be freshly prepared and given every forty-eight hours. Given judiciously, mercurochrome has proved to be one of the most efficient remedies used in ambulatory cases; patients can be treated in the dispensary and the clinic.

Expressed prostatic fluid and seminal fluid has decided bacteriostatic action. Patients showing a hypersensitiveness for intravenous mercurochrome injections will secrete a proportionally greater amount in the saliva and gastro-intestinal tract than by way of the kidneys. By the use of diphenylcarbazid test of mercury in the seminal fluid, and the mercurochrome kidney function test, it is possible with the first intravenous mercurochrome injection to detect patients that are not suitable for the continuous use of this drug.

Shoe Dye Poisoning (C. W. Muehlberger, Ph.D. *Journal of the American Medical Association*, June 27, 1925).—A survey of the medical literature indicates that nitrobenzene or aniline poisoning resulting from the use of shoe dyes is a common occurrence. Reports of forty-seven cases previously published from Europe and the United States during the last twenty years have been collected. Nine new cases of shoe-dye poisoning are reported. Six of these cases are known to have resulted from the use of shoe dye that contained aniline instead of nitrobenzene as the solvent. These are the first cases of aniline poisoning from shoe dye to be reported in the United States. The chemical analyses of four commercial preparations of black shoe-dye are given. All these were found to contain nitrobenzene or aniline. The most important symptom is cyanosis without apparent cause occurring in a previously normal person. Other less important symptoms are vertigo, headache, weakness and nausea Shoes should be removed and the patient kept in bed until the cyanosis clears. Oxygen inhalation is without effect on the cyanosis. The only way that this type of poisoning can be adequately prevented is by State or National Health regulations prohibiting the manufacture and sale of toxic shoe dyes. It is recommended that nitrobenzene and aniline be replaced by non-toxic solvents in order to eliminate the danger of poisoning.

Diphtheria of the Skin (Shields Warren, M.D., and Lee Sutton, Jun., M.D., *Journal of the American Medical Association*, June 27, 1925).—The skin lesions of varicella in a 5-year old boy took on an impetiginous character and became infected with *Bacillus diphtheriæ*, probably tranferred from the nostrils by scratching. They gradually progressed to extensive hæmorrhagic crusted lesions covering about 49 sq. cm. of body surface. Death apparently was due to toxæmia, and the necropsy findings were consistent with infection with *B. diphtheriæ*. Virulent diphtheria bacilli were recovered from one of the skin lesions, and the histologic picture of the lesion is that of diphtheric ulceration. Sections stained by the Gram-Weigert method showed bacilli morphologically resembling *B. diphtheriæ*.

Cephalandra indica (Telakucha) in Diabetes (R. N. Chopra and J. P. Bose, *Indian Journal of Medical Research*, July, 1925).—In Bengal this drug has the reputation of having a remarkable effect in reducing the amount of sugar in the urine of patients suffering from diabetes mellitus, and even among medical practitioners in Calcutta a strong belief exists as to its efficacy in glycosuria. The results of the author's experiments with *Cephalandra indica* (*Telakucha*) are, that it contains an enzyme with amylolytic properties, a hormone, and traces of an alkaloid. None of these substances reduces sugar when administered subcutaneously to rabbits. Fresh juice extracted from the leaves, stem and root of the plant produces no reduction of sugar in the blood or urine of patients suffering from glycosuria.

The Ketogenic Diet in Epilepsy (M. G. Peterman, M.D., *Journal of the American Medical Association*, June 27, 1925).—Thirty-seven patients with essential epilepsy were treated for periods of from three to thirty months by means of a high fat diet sufficiently restricted in carbohydrate and protein to produce ketosis. In two patients no change was noted. One patient improved while under control, but was lost from observation. Three patients remained free from convulsions for from three to eight months, and were then not heard of. Twelve improved and nineteen were free from attacks from the institution of this treatment. Thirty-two are still being kept under observation. The general physical development was also considered to have been normal and exceptionally good in certain cases. Resistance to infection seems in no way diminished by this form of treatment.

The Epidemiological Importance of Diphtheria Carriers (James A. Doull and Hilario Lara, *American Journal of Hygiene*, July, 1925).—Summary and conclusions of this article are as follows :—

In a study of 758 clinical cases of diphtheria in Baltimore, it was found that of 2,799 family contacts not receiving prophylactic anti-toxin, 59 or 2·1 per cent. were attacked later than one and not later than thirty days following the onset of the primary cause. In contrast to this, investigation has shown that in the family contacts of 1,044 school carriers, estimated to number 4,665, only fourteen cases were reported within thirty days of the discovery of the carrier. After making necessary allowance for differences in age-distribution of the two groups of contacts, it is a conservative estimate to state that the risk of attack is ten times as great for family contacts of cases as for those in similar association with known bacillus carriers. Comparison of the attack rates in families of carriers with the prevailing attack rates in the general public of the city indicates that during the first month following the discovery of the carrier the attack rate in the family contacts is considerably higher than would be expected in a random sample of the city's population of the same age-distribution, whereas in subsequent months no such excess is indicated. The interpretation of the excess attack rate in carriers' families during the first month of observation is complicated by a number of considerations which are noted in the presentation of the data. Nevertheless, it seems reasonable to conclude, since our statistical observations are in agreement with many other general facts known regarding the epidemiology of diphtheria, that the families of known bacillus carriers do incur a risk of developing clinical diphtheria which, though small, is appreciably higher than that incurred by otherwise comparable families in which such carriers are not known to exist.

It should be noted, however, that the evidence cited justifies this conclusion only as regards carriers discovered in schools where clinical diphtheria was prevalent at the time, for among the family contacts of chance carriers, found in a random sample of school population, there is no evidence of any greater incidence of diphtheria than that prevailing in the general population of the city. The number of carriers of this kind observed, namely 104 "virulent" and 261 "avirulent," is, however, too small to justify any sweeping conclusions regarding the risk of attack to which their family contacts are subject.

This study fails to show any significant distinction between the risk of attack for those exposed respectively to carriers classified as "virulent," "avirulent" and "not tested." The fact that such are not brought out by an analysis of the data which we have presented does not, however, justify the conclusion that differences do not exist, and it may be that the study of a larger number of families would indicate that the risk of attack may vary according to the type of bacillus harboured by the carrier.

The Severity of Hookworm Disease in a Chinese Group, tested by Hæmoglobin Readings for the Anæmia, and Egg Counts for the Degree of the Infestation (Norman R. Stoll, Sc.D., and Hsien-Wu Tseng, M.D., *American Journal of Hygiene*, July, 1925).—Egg counts and hæmoglobin readings were secured from 337 Chinese, living in the mulberry growing region, near Soochow, Kiangsu Province, China. There were 64 or 19 per cent. negatives to egg count, with an average hæmoglobin of 66·7, 0·7 per cent. Schistosomiasis was absent and dysentery was not an important complication, but malaria was present. The malaria is held to account for the low average hæmoglobins of the hookworm negatives, and probably also influenced the degree of anæmia in the hookworm positives. By means of the co-efficient of correlation, there was shown to be a sound degree of direct correspondence between the size of the egg counts and the degree of anæmia (or, the other way round, a valid, negative co-efficient of correlation between egg counts and hæmoglobins). This correspondence is as significant as in Darling's worm count data. This, then, constitutes most important direct evidence on the validity of egg count data, "basis of formed fæces," in analysing community infestation for hookworm disease. It constitutes indirect evidence also on the validity of the egg count technique, and a general correspondence between egg counts and worm infestations.

The Effect of Storage on the Potency of Antivenomous Serum (L. A. P. Anderson and Rev. J. F. Caius, *Indian Journal of Medical Research*, July, 1925).—The authors conclude that as regards the neutralizing power of antivenomous serum against cobra venom, this serum, like all other sera, gradually loses potency on keeping during the first six to nine months. A sudden increase in potency, to a degree higher than that originally possessed by the serum, follows the preliminary deterioration. The enhancement of potency is marked after twelve to fourteen months' storage. The enhanced potency of aged sera is not directly due to the particulate matter thrown down by ordinary centrifuging.

The Significance of the Splenic-Index in Kala-azar Endemic Areas (J. Dodds Price and C. Strickland, *Indian Journal of Medical Research*, July, 1925).—These observations were carried out on children from the Salana Tea Estate in Nowgong District, from which the following conclusions have been drawn. Rare pathological conditions are of no importance in using the spleen-index for malariometry. Kala-azar is of importance, but when the *clinical* signs of the disease are *not well marked* the splenomegaly of a community living in a kala-azar infected area is due to malaria. When the clinical signs of kala-azar are well marked the cases must not be used in a malariometric spleen-index. For malariometry other cases only should be taken for a spleen count, and the index read in conjunction with a parasite-index of all members of the community. The malaria-parasite-index approximates to the spleen-index in large communities subject to a mild incidence of malaria manifesting itself in an acute or sub-acute form. Any discrepancy between the two indices is correlated with the size of the community, its degree of malariousness and the degree of the chronicity of the disease among the individuals of the community.

Factors which should Determine the Selection of an Anthelmintic in a Geographical Area (Fred L. Soper, M.D., C.P.H., *American Journal of Hygiene*, July, 1925).—Four hundred and nineteen cases were treated with carbon tetrachloride, oil of chenopodium, or a combination of these two drugs. Efficiency rates for such treatments were calculated for species and sex on the basis of per cent. removed by first treatment, as tested by the administration of 3 c.c. of oil of chenopodium. Among Paraguayan soldiers and prisoners the average hookworm infestation is high; among boys and girls of the asylum a much lower degree of infestation exists. Seven per cent. of 82,856 hookworms classified were *Ancylostoma duodenale*. The present ratio between *Ancylostoma* and *Necator* is probably due to three factors: early introduction of *Ancylostoma* by Spanish colonists; the absence of negro slaves; and the occupation of Paraguay by the Brazilian Army with its known heavy *Necator* infestation, following the Paraguayan war. In Paraguay, *Ascaris* infestation is relatively low (11·7 per cent.), being but one-fourth that of *Trichuris* (43·4 per cent). No judgment of the relative value of the anthelmintics used as ascaricides can be made from the present study. The efficiency of all combinations used is low for *Trichuris*. Correction of total efficiency rates for distribution of worm population by species and sex of each group failed to cause over 2·5 per cent. difference in such rate of any group. Correction of species efficiency rates for equal sex distribution caused no appreciable difference in *Necator* rates, where the number of worms was relatively large; a maximum change of 3 per cent. occurred in certain groups in *Ancylostoma* rates where the number of worms was small. Oil of chenopodium and carbon tetrachloride both possess a species and sex selective action on *Necator* and *Ancylostoma*. Both are more active against *Necator* than against *Ancylostoma*. Oil of chenopodium is more efficient for males than for females; carbon tetrachloride is more efficient for females than for males. The best results were obtained for *Ancylostoma* with 2·8 c.c. of a 9 × 5 mixture of carbon tetrachloride and oil of chenopodium (1·8 c.c carbon tetrachloride and 1·0 c.c. oil of chenopodium). The Stoll egg-count method gave the same per cent. total reduction in hookworm infestation in 150 cases following trial treatment, as did the more laborious worm-count method. This last method was shown to be superior to the Willis and Stoll methods as a means of diagnosis of the presence of the hookworm. The method is *indispensable for the determination of the degree and character of infestation* and the study of *sex and species selectivity of anthelmintics*. No serious toxic symptoms were noted in 419 cases of this series. The maximum doses administered were: 3 c.c. oil of chenopodium; 2·4 c.c. carbon tetrachloride; and 2·8 c.c. of a 9 × 5 mixture of carbon tetrachloride and oil of chenopodium. Five serious (two fatal) cases (four alcoholics and one child with heavy *Askaris* infestation) have been encountered in 36,000 treatments with an adult dose of 2·4 c.c. of 3 × 1 and 2 × 1 combinations of carbon tetrachloride and oil of chenopodium. Pregnant women may be treated with moderate doses of carbon tetrachloride without danger.

The Association of Bacillus Bronchisepticus and Bacterium lepisepticum with Rabbit Snuffles (Carroll G. Bull and Clara M. McKee, *American Journal of Hygiene*, July, 1925).—It was found that *Bacillus bronchisepticus* is by far the predominating organism in the bacterial flora of the nares and trachea of rabbits developing snuffles in our stock animal room, pure cultures of this organism often being obtained. *Bacteria lepisepticum* appeared in small numbers in the cultures from five of these rabbits. An acute and fatal form of snuffles attacked an entire litter of baby rabbits. *B. bronchisepticus* was abundant in the cultures from all these rabbits, but *B. lepisepticum* did not appear at all. Cultures made from the nostrils of eighteen rabbits in an isolated colony passing through an epidemic of snuffles gave an abundant growth of *B. bronchisepticus*. *B. lepisepticum* could not be isolated from any of the cultures. Cultures from one rabbit gave neither *B. lepisepticum* nor *B. bronchisepticus*.

Note on the Anæsthesia produced by Intra-Arterial Infection of Apothesine (L. P. Arland, *Indian Journal of Medical Research*, July, 1925).—The chief points noted in this paper are, that the anæsthesia was perfect and profound. There was present both motor and sensory paralysis. There was no sign of shock. Duration of anæsthesia was not sufficiently long to permit of any operation on the limb being performed. No bad effect was noticed during or after the injection. The anæsthesia was either due to (*a*) paralysis of the nerve-endings, or (*b*) to the paralysis of the nerve-trunks in continuity.

A Study of Trichomonas from the Guinea-pig (Misao Tanabe, *Journal of Parasitology*, March, 1925).—The trichomonas from the guinea-pig in Baltimore agrees with that described by Kuczynski, except that from the standpoint of size; one large and another smaller species seem to exist. An inner row of chromatic granules is present, although not so distinct as in *Trichomonas* from the mouse Anterior to the nucleus, there is a small number of chromatic granules. Posterior to the nucleus, there is usually a group of chromatin granules which often seems as if arranged in four or five rows.

The Fungicidal Activity of Certain Volatile Oils and Stearoptens (Harold B. Myers, M.D., and Clinton H. Thienes, M.D., *Journal of the American Medical Association*, June 27, 1925).—Thymol oil of cinnamon and oil of clove have been found particularly efficacious in destroying a pathogenic yeast-like organism responsible for an occupational dermatitis. The drugs mentioned have been found equally valuable in causing an immediate improvement, progressing to healing of infections apparently due to fungoid organisms of several types. The results reported warrant further trial of the volatile oils and stearoptens in infections due to fungoid organisms.

Ivy Poisoning. Preventive Treatment, with Special Reference to the Element of Individual Susceptibility (G. L. Krause, M.D., and F. D. Weidman, M.D., *Journal of the American Medical Association*, June 27, 1925).—It is confirmed that the discharge from the lesion does not disseminate the disease. The virus itself must come in contact with the part. Susceptible individuals may contract ivy poisoning at any time of the year, provided the juice of the plant comes in contact with the skin. As new findings it is reported that repeated attacks tend to shorten all the stages of subsequent attacks. Local immunity is not developed by repeated attacks of ivy poisoning. There is such a thing as absolute (and probably permanent) immunity against ivy poisoning. In series taken, two-thirds of the men who believed themselves immune were not immune. In 45 per cent. of the susceptibles it was necessary that some such defect in the epidermis, as scratches, should be present before a dermatitis would develop. It appears that all of the commoner laboratory animals are immune to this virus. Pruritus ani, transient, appeared in the majority of those receiving preventive treatment. In two subjects, hæmorrhoids were aggravated. The pain at the sites of intramuscular injections outweighs the danger of future attacks of ivy poisoning such as are only suppositions in the commoner walks of life. In a series of controlled subjects the preventive system of treatment of Strickler did not prevent. It is possible that the curative value of this system is likewise scant or *nil*, and that the beneficial results which have been reported are dependent on and ascribable to the variable susceptibility of different individuals and the varying intensity of the irritant as applied at different times.

Treatment of Gastric Ulcer by the Method of Duodenal Alimentation (A. L. Garbat, M.D., *Journal of the American Medical Association*, June 27, 1925).—In the treatment of gastric or duodenal ulcer by means of prolonged duodenal alimentation, stress should not be laid entirely on the exclusion of food from the stomach. Great importance is attributed to the frequent concomitant administrations of antacids or alkalis by mouth before each duodenal feeding, in order to neutralize or prevent the gastric secretion which is almost regularly associated with the duodenal alimentation. The two-tube method has shown that a reflow of duodenal feeding into the stomach occurs more frequently than is usually believed; this occurs with improper position of the tube, which cannot always be recognized, or with a patent pylorus of the stomach. Antacid therapy will help to minimize the disadvantages resulting from such regurgitation.

The Treatment of Amœbiasis by Oral Administration of Stovarsol (Foster M. Johns, M.D., and S. Chaille Jamison, M.D., *Journal of the American Medical Association*, June 20, 1925).—Forty-six patients with amœbiasis were treated with stovarsol with very favourable results. A series of twenty-seven patients was kept under observation for some time to determine the permanence of the "cure." Twenty-one patients have remained well and free from parasites for an average of 3·9 months. One patient rapidly relapsed within periods of from three to seven days. The results of treatment of amœbiasis with stovarsol are equal to any other drug or method of treatment ordinarily employed. It is reasonable to expect that better results will be obtained whenever the most effective method, with reference to dosage and duration of treatment, will have been determined.

Chronic Hereditary and Familial Hæmolytic Jaundice (Walton Forest Dutton, M.D., *Journal of the American Medical Association*, June 20, 1925).—The cases of chronic hereditary and familial hæmolytic jaundice with splenomegaly and hepatomegaly under study differ from the usual forms of hæmolytic jaundice. They differ in the very decided functional activity of the liver and its relation to the reticulo-endothelial system. During the periods of crises, the concomitants of ordinary obstructive jaundice, such as clay-coloured stools, choluria, mild pruritis and slight icterus are present. The blood picture is markedly characteristic, but at times exaggerated. This makes the diagnosis comparatively easy. An intimate study of these cases appears to implicate the extrahepatic bile passages and the reticulo-endothelial system. In the production of crises, the neuromuscular reflex apparatus of the bile passages plays an important rôle. A total spasm of the region of the sphincter of Oddi with contractions of the gall-bladder, which forces bladder-bile back to the columns of the liver cells, produces a toxic irritative process or defence reaction.

Effect of Various Agents — Ultra-violet Light, Vaccines, Turpentine, Neoarsphenamin and Autoblood Injections—on the Enzymes of Blood and Skin (Jay Frank Schamberg, M.D., and Herman Brown, B.S., *Archives of Internal Medicine*, May 15, 1925).—Ultra-violet light, in the strengths used by the authors from an Alpine lamp, appears to decrease the lipolytic activity of the blood-serum both in rabbits and in human beings. On the other hand, the proteolytic activity of the blood-serum appears to be increased. The intramuscular injection of therapeutic doses of turpentine in olive oil tends to increase the lipolytic and proteolytic power of the blood-serum both in rabbits and in human beings. Limited observations on the effect of subcutaneous injections of staphylococcic vaccines suggest that they tend to increase both the lipolytic and proteolytic activity of the blood-serum. The intramuscular injection of freshly drawn autoblood appears to stimulate an increase in the lipolytic and proteolytic activity of the blood-serum. Observations on two cases suggest that the intravenous injection of small quantities (1·5 c.c.) of distilled water tends to decrease the lipolytic activity of the blood and perhaps the preteolytic power. The exposure of rabbits to ultra-violet light from an Alpine lamp decreases the lipase and the protease in the skin of an animal. In summarizing, it may be said that injections of vaccines, turpentine and autoblood appear to increase the lipase and protease in the blood, while huge doses of neoarsphenamin and small doses of distilled water tend to decrease them. Ultra-violet light depresses the lipase and stimulates the protease.

Monilia as a Possible Etiologic Factor in Psoriasis (Moyer S. Fleisher, M.D., and M. Wachowiak, M.D., *Archives of Dermatology and Syphilology*, June, 1925).—In a series of thirty cases of psoriasis, the authors have found *Monilia* or monilia-like organisms in the fæces in 82 per cent., in the blood in 21 per cent., in the skin scrapings in 46 per cent. In normal subjects, *Monilia* was found in only 6 per cent. of 100 stools; on the skin of unexposed portions of the body (27 cases), and in blood cultures in no cases. It appears that the use of a vaccine prepared with these organisms is of some value in the treatment of psoriasis.

Value of Chlorin in the Treatment of Colds (Harold S. Diehl, M.D., *Journal of the American Medical Association*, May 30, 1925).—Most opinions as to the value of the various forms of treatment for colds have been made without careful analyses of results and comparisons with control series. In this study the results of the chlorin treatment of 425 students with colds are compared to the results of the medical treatment of 392 students. It seems that the beneficial effects from the chlorin treatment are all experienced within the first day after the treatment. The percentage of patients who recover within one day with the chlorin treatment is definitely higher than with the medical treatment; 19·5 per cent. of those having chlorin and 12·5 per cent. of those having medical treatment recovering in one day. Of the group with acute rhinitis 23·6 per cent. of the ones treated with chlorin and 6·7 per cent. of those with medical treatment recovered within one day. Of the entire series, 51·4 per cent. of those treated with chlorin and 47·9 per cent. of those given medical treatment recovered in three days; while 73·3 per cent. of those treated with chlorin and 72·6 per cent. of those with medical treatment recovered within a week. The large percentage of recoveries within three days and seven days under such a variety of medical treatments is evidence only of the self-limited character and short duration of most colds. The chlorin treatment apparently was more beneficial in acute rhinitis than in any other type of acute cold. The largest percentage of good results with the chlorin treatment was obtained when the patients were treated on the second or third day of the disease. Ill-effects that could be definitely ascribed to the chlorin treatment occurred only in persons subject to asthma. The results of the treatment of whooping-cough were somewhat encouraging, but not conclusive.

Results with the Skin Test for Susceptibility to Scarlet Fever. Preventive Immunization with Scarlet Fever Toxin (George F. Dick, M.D., and Gladys Henry Dick, M.D., *Journal of the American Medical Association*, May, 16, 1925).—The results reported show the practical value of scarlet fever toxin used in skin tests for susceptibility and active immunization for the prevention of scarlet fever. It has been demonstrated that the toxin may be administered with safety in doses large enough to confer complete immunity. Active immunity is developed within two weeks, and it lasts at least a year and a half.

The Value of Flumerin in the Treatment of Syphilis (James C. Fox, Junr., M.D., Georges H. Gildersleeve, M.D., and John F. Preston, M.D., *Archives of Dermatology and Syphilology*, June, 1925).—The requirements for the final acceptance of a new anti-syphilitic drug, as suggested by Stokes, seem to have been fairly well fulfilled in the case of flumerin. The points in connection with its chemistry and toxicity have been carefully studied. Its value in the treatment of rabbit syphilis, carefully controlled by the method of nodal transfer as a criterion of cure, has been thoroughly established. Also, its superior curative power, as compared with other mercurials, has been shown for experimental syphilis. So far as its clinical value in the treatment of human syphilis is concerned, there is substantial agreement between the opinions of the three groups of workers who have studied the drug; that is, flumerin is inferior to the arsphenamin group in therapeutic value, but superior to other mercurials

in common use. It should be used only in conjunction with the arsenicals or in patients shown to be intolerant or resistant to them. While the toxicity factor is not a grave menace, it must be carefully guarded against in using this drug. The chief disadvantage of flumerin seems to be that it complicates rather than simplifies a programme of anti-syphilitic treatment. The great problem to-day in the cure of syphilis on a large scale is how to keep the syphilitic patient under a prolonged sustained treatment. Incorporation of injections of flumerin twice a week in the interim between arsenical courses calls for such an expenditure of time, energy and money (on the patient's part) that the therapeutic gain must be definitely proved to be commensurate. In early syphilis, in which the importance of an intensive, sustained, combined arsenic and mercurial treatment is so vital to the future welfare of the patient—both for the production of a permanent clinical and serological cure as well as for the prevention of the tragic neuro-recurrence—the superior value of flumerin seems to outweigh the economic consideration.

Hæmophilia. Study of the Blood, the Clinical Course and the Heredity in Three Cases (Ed. C. Davidson and Irvine McQuarrie, *Bulletin of the Johns Hopkins Hospital*, May, 1925).—A typical, large hæmophiliac family is described in which fourteen proven cases of hæmophilia have occurred in eight generations. Detailed reports of two of the cases representing the sixth and seventh generations are presented. Two normal female members of the same family presented no evidence of the disease, either clinically or from blood examination. The hereditary transmission occurred in the family according to the law of Nasse. No occurrence of the disease in females and no transmission through the males of the family has been observed. Of the females capable of transmitting the disease, 83·3 per cent. are known to have done so. Among the potential hæmophiliacs 51·8 per cent. have proved to be bleeders. One typical case of sporadic hæmophilia is described. The clinical picture and the blood abnormalities are identical in the sporadic type and in the hereditary type of the disease. The blood-coagulation time and the prothrombin time in the cases of hæmophilia were from twice to twenty-five times as great as the normal. They both varied from time to time to a considerable degree in the case of each individual with hæmophilia. The finding by Minot and Lee of a qualitative platelet deficiency without a diminution in the number of platelets has been confirmed. The bleeding time, the capillary resistance, the nature of the blood-clot when finally formed, the amount of blood-calcium and the number of platelets were at all times found to be normal in the cases of hæmophilia studied. Blood transfusion is the most effective form of treatment for the hæmorrhage in hæmophilia and should be employed as a prophylactic measure preceding surgical operations.

Current Literature.

INDIAN MEDICAL GAZETTE,
July, 1925.

Cholera in Bengal: Past and Present (A. B. Fry).—This paper is written in answer to two questions put forward at a meeting of the Committee of the Office Internationale d'Hygiène Publique, i.e.: (1) Is Bengal nowadays the endemic home of cholera, as it used to be in the past? (2) Does Bengal still spread endemic cholera throughout India and thence to the rest of the globe? The author has reviewed the literature on the subject, and gives his own studies on the disease, the conclusions of which are as follows: India may still be regarded as the home of cholera and deltaic Bengal may still be considered the endemic home where endemic cholera is just as regular and severe as ever. That there is a fair body of evidence to show that cholera in the rest of India is dependent on cholera in Bengal, but owing to increased facilities for and rapidity of travel, it is not so easy to trace the spread. Why deltaic Bengal is the endemic home of cholera is not proved. It is obvious that density of population, conditions of humidity of air and soil, and of winter and summer temperature, are suited to the requirements of the infecting agent, and that the notorious carelessness of the people regarding their drinking water favour its spread; but we want to know to what extent the "chronic carrier" exists. That the deltaic region of Bengal is the place where cholera should be attacked. Of all preventable diseases cholera is the easiest to tackle, and could we get to grips with it in this region, we might ultimately wipe it off the earth. The author suggests intensive vaccination in a selected district and a very rigorous propaganda campaign. If this is successful, to extend it throughout the province. It is our very obvious duty to take the most stringent measures at the ports and frontiers to prevent the spread of the disease.

Canine Leishmaniasis in Bombay (R. Row).—This disease is rare in Bombay, and communications on the subject lead one to believe that resistance to leishmaniasis in the pariah dog is strong. The case here reported was a quasi-bulldog; it was found to have extensive ulcers on the lips, ears, nose and inner canthus of the left eye. There were also a number of non-ulcerated lesions on the inner side of the ears looking like shining buttons of the size of large peas. The character of the ulcers and the nodules suggested cutaneous leishmaniasis at a glance, although the ulcers had greatly altered in appearance by septic infection set up by constant scratching by the animal. The ulcers healed up in about six months under treatment at the Veterinary Hospital, Bombay, leaving not a single scar. The morphological, cultural and infective characters of the parasite seem to make it a distinct species from *Leishmania tropica* found in man.

Preliminary Observations on Acquired Diseases of the Heart and Aorta as met with in Bengal (Uma Prasanna Basu).—These observations are based on

446 cases examined by the author during the course of hospital and private practice in Bengal. From the statistics of the different varieties of cases it is evident that structural lesions of the heart and aorta due to acquired diseases differ widely from those seen in the clinics of Europe. The chief reason for this difference is the climate. The factor next of importance in the production of a degenerated myocardium is the poverty of the masses from dearth of industrial developments in Bengal.

A Note on the Efficacy of Neem-Battis *in the Destruction of Rats and Rat-Fleas in Rat Burrows* (C. D. Tiwari and R. B. Lal).—During experiments on disinfestation of houses by fumigation with cresol, &c., it was found that the fleas in the rat-holes were not killed and the rats were not at all affected. Experiments were therefore carried out by fumigation with *neem-battis*, as issued from the Punjab Plague Equipment Depôt, Jullunder. With this method the rats and the fleas on the rats in the burrows in the fields are killed in five minutes.

Cellular Elements in Cholera Stools and their Relative Importance in Diagnosis of the Disease (G. C. Maitra and R. L. Behari Ganguli).—In a total of 495 cholera cases, diagnosed bacteriologically, comma-vibrios were found microscopically in 84 per cent. of the stool films. In a total of 496 cholera cases 92 per cent. showed definite concentration of blood. In 6 per cent. of them the concentration was indefinite, and in 2 per cent. there was no concentration at all. Cytological elements in the cholera stool are constant and characteristic, and can be utilized as a reliable index in 98 per cent. of cases.

A Note on the Cultivation of an Entamœba from a Monkey (*Macacus rhesus*) (B. M. Das Gupta).—A monkey experimentally infected with *Trypanosoma evansi* died, and the post-mortem was carried out within four hours of death. Very scanty, sluggishly motile entamœba were found in the contents of the cæcum. No evidence of ulceration in the cæcum or in any other part of the large gut. Positive cultures of *E. nutalli* Castellani were obtained. The author has also cultivated *Entamœba histolytica* both from kittens experimentally infected and from the stool of a human case of amœbic dysentery.

Medical News.

CHINESE GRADUATES IN PRACTICE.

A recent census of the graduates of the former Union Medical College, Peking, China, shows that 27 per cent. of the graduates are in private practice, 23 per cent. in Government posts, and 39 per cent. in missionary work.

CERTIFICATION OF CURE OF LEPROSY.

The conditions under which lepers are released from the leprosarium at Carville, Louisiania, include special observation for one year, monthly bacteriologic examinations to show that the lepra bacillus is absent from the tissues and the certification of cure by a board of three medical officers stationed at the hospital. Four lepers who went to the Carville home a few years ago have recently been discharged. There are at present 236 leper patients at Carville.

THE CULION LEPER COLONY (PHILIPPINE ISLANDS).

At the present time there are 5,103 lepers in the colony; four of them are Americans, one is a European, one a Japanese, and seventeen Chinese. The total number comprises 2,487 men and 1,318 women.

New Preparations, Inventions, &c.

DIBROMIN (PARKE, DAVIS & Co.).

A crystalline synthetic compound containing approximately 56 per cent. of bromine in loose combination. When its solutions are brought into contact with infected tissues the bromine is slowly liberated and exerts a powerful germicidal action.

Dibromin is stable in the dry state; its solutions are easily made, are definite in strength, do not stain, do not irritate, and are practically non-toxic.

Dibromin is employed in dilute aqueous solutions, ranging in strength from 1 in 10,000 to 1 in 2,500. Such solutions may be applied by continuous irrigation, as in the treatment of extensive wounds, ulcerations, &c., and for infections of the urethra, bladder, or uterus. Weak solutions are suitable for use as mouth washes and as collyria in eye infections.

Dibromin is supplied in 6-grain capsules (in bottles of 10 or 50 capsules) for convenience in making solutions without weighing—the contents of 1 capsule added to 7 pints of water forms a 1 in 10,000 solution.

OLGAR (P. D. & Co.).

This preparation consists of highly purified liquid paraffin emulsified with agar. It has the appearance and consistence of thick cream and is agreeably flavoured. The paraffin is rigorously tested to ensure freedom from injurious by-products.

The administration of olgar is indicated in cases of chronic fœcal stasis and the various forms of auto-toxæmia resulting therefrom; in catarrhal conditions of the intestine, hæmorrhoids, &c. Its action, of course, is purely mechanical, it lubricates and soothes the intestinal mucosa, softens the intestinal contents, and facilitates peristalsis. The dose for an adult is one tablespoonful night and morning. It is supplied in 16-ounce bottles.

SILVER NITRATE SOLUTION CAPSULES (P. D. & Co.).

These capsules provide an exceptionally convenient means of always having at hand in aseptic condition the 1 per cent. solution of nitrate of silver for application to the eyes of infants at birth.

The capsules are formed of a special wax, and each contains about 5 minims of the solution, which is easily expelled by pressing the capsule between thumb and finger after an aperture has been made with a sterile needle. Two of these capsules are supplied in a tin together with a puncturing needle aud directions for use.

STORAXOL (P. D. & Co.).

This ointment is a combination of storax, resorcin, menthol, camphor, carbolic acid (5 per eent.) and precipitated sulphur in an emollient base of penetrative character. The parasiticide, antipruritic, antiseptic and analgesic properties of its constituents render storaxol of value in various skin disorders, e.g., chronic eczema, ringworm, pruritus, urticaria, impetigo, psoriasis. It affords one of the best means of treating scabies and parasitic affections of the scalp. It forms an excellent dressing for foul ulcers, and is reported to be very effectual in allaying the itching of piles. It is supplied in convenient collapsible tubes, also in jars containing 1, 5, or 10 pounds.

Original Communication.

FURTHER OBSERVATIONS ON PRURITUS ANI AND PRURITUS VULVÆ OF MYCOTIC ORIGIN.

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SINCE 1912 I have carried out a mycological and bacteriological investigation in practically every case of pruritus ani I have observed, and in a comparatively large proportion of cases, more than 20 per cent., fungi, usually of the genus *Epidermophyton* were found.

In 1923, in my paper on "Medical Mycology," published in *The British Medical Journal*, December 1, page 1037, I described as a separate entity "Pruritus Ani of Mycotic Origin." This publication attracted little attention and even in very recent articles on pruritus ani by various authorities the mycotic or fungal variety is not mentioned, although the so-called bacterial type (streptococcus pruritus ani) is often discussed.

It may perhaps be of advantage to give a brief general account of the condition, incorporating into it the result of my further researches on the subject.

Definition.—Mycotic (Phycotic) Pruritus Ani is a form of pruritus ani caused by fungi higher than bacteria (mycetes, higher fungi), generally fungi of the genus *Epidermophyton*, the same fungi which cause pruritus interdigitalis pedum (toe phytosis, dermatitis interdigitalis mycotica, mango toe) and also ordinary dhobie itch or tinea cruris. The condition is, in fact, as a rule a latent epidermophytosis of the perianal region without the usual objective symptoms of an ordinary active epidermophytosis being present.

Synonyms.—Phycotic pruritus ani, mycetic pruritus ani, mycotic pruritus ani, fungal pruritus ani; pruritus ani due to the higher fungi; epidermophytic pruritus ani.

Clinical Symptoms.—The patient complains of very severe pruritus, not, as a rule, continuously but at intervals. The pruritus is often worse at night, but the attacks of unbearable itching may come at any time. The inspection of the ano-perianal region in recent cases may reveal nothing at all except perhaps signs of scratching, but in most cases on careful examination minute, red, slightly raised, infiltrated patches may be seen in the perianal region, occasionally arranged into two curved lines. In a number of old cases signs of an eczematous dermatitis, due to scratching, are present, and streptococcus and other secondary bacterial infections may become engrafted on the mycotic condition.

When the secondary bacterial infection becomes very abundant, especially if many coli and proteus germs are present, the fungus may disappear completely or become extremely scarce. In some old-standing cases the skin is thickened and lichenified.

Illustrative Cases: *Case* I (Uncomplicated type).—This case has already been published by me in the JOURNAL OF TROPICAL MEDICINE. The patient, a Ceylon planter, came to consult me in October, 1924, he had been suffering from anal pruritus for six years and had tried numerous ointments and lotions without any permanent benefit. Denied ever having had dhobie itch or mango toe (dermatitis interdigitalis pedum). The examination of the ano-perianal region did not show anything abnormal, except on close examination a very few minute red patches which did not give the impression of an epidermophytic infection. Scrapings were made every other day for two weeks, and were examined microscopically in liquor potassæ; they were always negative except on one occasion, when a few spores and portions of mycelial threads were seen. After many failures a fungus was grown with all the characteristics of *Epidermophyton cruris*. An ointment containing salicylic acid, eucalyptus oil, mercury salicylate, bismuth subnitrate (Deek's ointment), cured the condition.

Case II.—Mr. A. G., aged 40, has never been out of Europe. Six years ago began complaining of pruritus ani after a sojourn of several months in the South of France. Was treated with various ointments without any distinct benefit. Came to consult me in February this year. The skin about the anus was red and somewhat thickened. The inspection of the inguino-crural region showed absence of dhobie itch and the patient denied ever having had it. On questioning him I elicited the fact that he had been suffering from pruritus interdigitalis pedum for several years; inspection of the toes showed a few cracks and slight peeling. From scrapings of the toes I obtained *Epidermophyton cruris* fairly easily, but scrapings from the ano-perianal region, made and examined daily, remained negative for nineteen days, when a few mycelial segments of a fungus were found. The fungus was grown with very great difficulty owing to the presence of numerous cocci and bacilli; it was *E. cruris*. In this case a sulphur salicylic ointment and a tar ointment answered well.

Case III.—Mr. N. B., aged 25, has been in the Far East for three years. He had dhobie itch two years ago, which he says was cured by using a Goa powder ointment. For the last six months he had severe pruritus ani. Consulted me two months ago. The examination of the ano-perianal region showed nothing except signs of scratching. After many attempts, *E. cruris* was grown.

Ætiology.—The cause of the condition is generally to be found in the presence of fungi of the genus *Epidermophyton*, the same fungi which produce ordinary tinea cruris (dhobie itch) and pruritus interdigitalis pedum; occasionally fungi of the genus *Trichophyton* may be present. The species of *Epidermophyton* found have been *E. cruris* and *E. rubrum*. It may perhaps be useful to touch briefly

upon the botanical characters of epidermophyton fungi:

Genus *Epidermophyton* Lang, 1879, *emendavit* Sabouraud, 1907.

Definition.—Trichophytinæ with mycelial filaments and spores present in the lesions, and with pluriseptate spindles present in the cultures. Do not attack the hair or hair follicles, but grow in the superficial layers of the epidermis.

Type Species.—*Epidermophyton cruris* Castellani, 1905 (synonyms *E. inguinalis*, Sabouraud, 1907; *E. castellanii*, Brooke, 1908).

Remarks.—The fungi belonging to this genus grow superficially on the skin without invading the hairs and hair follicles; certain authorities however state that they may infect lanugo hair; do not produce suppuration. Reproduction takes place principally by pluriseptate spindles, with, on the average, four to six cells. The septa, as noted by Pinoy, may not be complete, and the cavities may communicate. Spiral hyphæ, as found in most species of trichophyton, are absent; pectinate structures, as found in the microsporons, are absent; no spore-bearing hyphæ, with lateral conidia of type *Acladium*, as noted both in the trichophytons and in the microsporons. The cultures undergo rapid degenerative changes, losing their characteristics, and becoming covered with abundant uniform, long whitish duvet (pleomorphism). They are not inoculable into guinea-pigs, except Pinoy's *Epidermophyton simii*. The species so far known have been isolated from human lesions, except the epidermophyton discovered by Pinoy in monkeys.

TABLE OF EPIDERMOPHYTONS.

Genus.	*Species.*
Epidermophyton Lang, 1879, *emendavit* Sabouraud, 1907	*E. cruris* Castellani, 1905. *E. perneti* Castellani, 1907. *E. rubrum* Castellani, 1907.

These species may be recognized by their growth on Sabouraud's agar:—

(*a*) Colour: peculiar yellow ... ... *cruris*
(*b*) Colour: pinkish ... ... *perneti*
(*c*) Colour: deep red ... ... *rubrum*

For *E. simii* Pinoy, 1911, Chalmers and I created the genus *Pinoyella*.

Epidermophyton Cruris CASTELLANI, 1905.

Synonyms.—*Trichophyton cruris* Castellani, 1905; *Epidermophyton inguinalis* Sabouraud, 1907; *T. castellanii* Brooke, 1908.

Found first in cases of dhobie itch (tinea cruris) in Ceylon by Castellani, and later in France by Sabouraud. The fungus is very abundant in recent cases, extremely scarce in old ones. The mycelial tubes in recent cases are generally straight, have often a double contour, and the segments are somewhat rectangular, their breadth being 3½ to 4½ microns. Branching is not rare. The spores are rather large (4 to 7), roundish and have generally a double contour; they do not collect in clusters. In chronic cases degeneration forms of the fungus are met with; the mycelium may be banana-shaped, may show several constrictions, or long strings of ovoid elements may be seen.

This *Epidermophyton* grows well, but rather slowly, on glucose and maltose agars. The growth begins to be visible after four to eight days, the colonies being at first of a peculiar yellow colour, lemon-yellowish or orange-yellowish, occasionally with a greenish tinge. Later they become white, with pulverulent surface, and may be acuminate or crateriform. Pleomorphism, with abundant white duvet, develops quickly.

This fungus is the commonest species found in cases of tinea cruris in Europe, India and Ceylon. It is not inoculable into guinea-pigs. Attempts at reproducing the eruption in man by inoculating pure cultures have generally failed, but De Silva and others have recently succeeded in reproducing the disease.

Epidermophyton perneti Castellani, 1907.—This fungus has been described by Pernet. It differs from *E. cruris* by growing much more rapidly on Sabouraud's agar and by the cultures having a delicate pinkish colour, which is generally lost in subcultures. It is a rare fungus.

Epidermophyton rubrum Castellani, 1909. *Synonym*—*Trichophyton purpureum* Bang, 1910. — This fungus was described by me in Ceylon, in 1909, and by Bang in France, in 1910. On maltose agar the growth begins to appear four to six days after inoculation as a raised red spot, which gradually enlarges. At complete development the growth is of a deep red colour, either with a central knob or crateriform, and is partly covered with a white delicate duvet. In old cultures the white duvet is much more abundant and thicker, and may hide the red pigmentation almost completely.

On *glucose agar* (4 per cent.), which is the best medium for this fungus, the growth is of a very deep blood-red colour, and the red pigmentation may spread to portions of the medium itself. In old cultures abundant white, occasionally white-greenish duvet, is present. This may hide the pigmentation, but, scraping out the duvet, the red pigmentation will be found to be still well marked. On ordinary agar and glycerine agar the fungus grows fairly well, but there is no red pigmentation.

Trichophyton. — Very occasionally fungi of the genus *Trichophyton* Malmsten 1845, may be found. As, however, these cases are rare, and the botanical characteristics of the genus are well known, there is no need of entering into any botanical details.

Monilia.—In a few cases of pruritus ani I have found fungi of the genus *Monilia* Persoon and other yeast-like organisms, but I doubt whether they play an important part in the causation of the pruritus; they probably play the rôle of secondary invaders, similar to the rôle played by many bacteria, such as the streptococcus. A case of so-called streptococcus pruritus sent to me recently turned out to be a case of epidermophyton infection, due to *Epidermophyton cruris*. The streptococcus was abundantly present, but was not the actual cause of the pruritus. Streptococcus vaccine caused no improvement whatever in the local condition, while an antimycotic treatment with sulphur and salicylic acid cured it.

Diagnosis.—A definite diagnosis of mycotic pruritus ani cannot be made without fungi being found microscopically or by mycological cultural methods; a diagnosis of probability can often be made, however, on clinical grounds, the minute, red, infiltrated patches, fairly often seen on careful examination (with no oozing in uncomplicated cases) in the perianal region being suggestive, especially if the patient is suffering from mycotic dermatitis of the toes or gives a history of having suffered from dhobie itch or tinea cruris in the past.

Course and Prognosis.—The course of the condition is chronic, but periods of great improvement and apparent cure may alternate with periods of severe recrudescence.

Attention should be called to certain cases, fortunately few, in which, although after the fungus under appropriate treatment has completely disappeared, the pruritus still continues. This is observed in highly strung, very nervous individuals. Very difficult cases are also patients suffering from, or having a tendency to true eczema; when they become infected with the epidermophyton fungi, either the irritation caused by the fungi themselves or set up by the treatment to eradicate them may start an attack of eczema not only in the ano-perianal region but in many other regions of the body.

Treatment.—In uncomplicated cases with no secondary eczematous dermatitis an ointment containing precipitated sulphur and salicylic acid, 15 or 30 gr. of each to the ounce of vaseline, may be applied with care. A preparation which is often

efficacious is Deek's ointment, which consists of salicylic acid 4 parts, bismuth sub. 10 parts, mercury sal. 4 parts, oil of eucalyptus 4 parts, vaseline and lanoline sufficient to make up to 100 parts. It is interesting to note that long ago Deek found that this anti-mycotic ointment had a very beneficial action in many cases of pruritus ani, although the existence of a mycotic type of the condition was not known at the time. Collosol iodine oil is at times useful.

In certain cases an ointment containing 2 gr. of chrysarobin to the ounce of vaseline is efficacious, but it may occasionally induce a severe reaction and it stains, of course, the underclothing. It should not be used when there is any affection of the kidneys, and the patient should be told never to touch his face and eyes after applying the ointment.

A strong lotion of potassium permanganate (15 gr. to 1 dr. to distilled water 1 ounce) is occasionally useful.

When the pruritus is unbearable, painting the parts with a lotion consisting of arg. nitr. 15 gr., spir. æther. nitr. 1 oz., at times stops the itching, either immediately or after a short period of time, during which the pruritus may become intensified; this paint should be used with care.

In chronic cases X-rays treatment is to be recommended; it is often successful, though, unfortunately, not always.

When a weeping eczematous dermatitis due to scratching is present with severe acute symptoms of inflammation, it is advisable in most cases at first to give a soothing treatment such as lead or lead and opium lotion or a lotion containing 1 per cent. resorcin and 2 per cent. of boric acid, and warm sitz baths, liquor plumbi being added to the water in the proportion of 1 oz. for each pint, are soothing. As soon as the acute eczematous dermatitis has disappeared, or greatly improved, the antimycotic treatment should be started.

When the mycotic affection develops in an individual suffering from true eczema, the treatment is most difficult, at times almost hopeless; the continuous application of resorcin lotion (1 per cent.) or resorcin boric lotion (resorcin 1 per cent., boric acid 2 per cent.) or a salicylic lotion (1 in 1,000) is best in most cases. Later on, gradually, ointments may be used containing tar (such as sphagnol) or resorcin (2-5 per cent.) or salicylic acid (2-5 per cent.) or beta-naphthol (2 per cent.).

In neurotic individuals in which the pruritus persists after the mycotic affection has been cured, bromides in full doses, phenazon, belladonna, tinct. cannabis indica, occasionally quinine hydrobromide, are useful, but the treatment is most difficult.

Prophylaxis.—A useful measure after the daily bath is washing the ano-perianal region with tar soap or mild carbolic soap, dry the parts well and apply a mildly antiseptic powder such as zinc oxide, acidi borici and starch equal parts; or boric acid and talc.; or dermatol 1 dr. and talc. 1 oz., or bicarbonate and talc. (sodii bic. 1 dr., talci. 1 oz). The underclothing should be changed as often as possible.

Pruritus Vulvæ of Mycotic Origin.

This condition is very similar to pruritus ani of mycotic origin, and it is not rare to observe female patients suffering from both conditions.

Ætiology.—Mycotic pruritus vulvæ is caused by the presence of fungi of the genus *Epidermophyton*, occasionally of the genus *Trichophyton*, which remain dormant in the external region of the labia majora without giving rise to the ordinary signs of active dhobie itch. Not rarely yeast-like fungi of the genus *Monilia* may also be found—the fungi of vaginal as well as oral thrush—but in my experience it is rather doubtful whether they can alone give rise to severe pruritus, as under an appropriate treatment monilias may be made to disappear, but the pruritus persists. Monilias probably play the rôle of secondary invaders similarly to the many bacteria so often found in the condition among which are various cocci and coli organisms.

Clinical Symptoms.—The patient complains of very severe pruritus in most cases at intervals. The examination of the genital parts may reveal nothing at all, but at times a few minute, red, hardly raised infiltrated patches may be seen. In long standing cases an eczematous moist dermatitis often develops, due to secondary bacterial invasion. In chronic cases there is often a large amount of vaginal discharge, in which various bacteria are found, and fairly frequently monilia fungi.

Illustrative Case.—An elderly spinster consulted me some time ago for vaginal pruritus of some years' duration, which had been treated by different medical men in various ways without any distinct amelioration resulting. In the perianal region, on the perineum and on the labia majora a very few small reddish patches were seen, which, it was thought, might be due to secondary pyogenic infection produced by scratching. There was an abundant purulent vaginal discharge from the anus, with symptoms of proctitis. A complete mycological and bacterial investigation was carried out. From the scrapings of the perianal region and from the labia majora a fungus was grown with the characters of *Epidermophyton cruris* Castellani, 1905, the fungus which is the commonest cause of dhobie itch and pruritus interdigitalis pedum. In the vaginal and in the rectal discharge enormous numbers of monilias were present, with very few bacilli; cultivation showed the fungus to be a strain of *Monilia pinoyi* Castellani.

The following treatment was given: creosote was administered by the mouth. Tinct. iodi., which in this case did not give rise to any local pain or irritation, was freely applied once a day to the ano-perianal region, the perineum and the external surface of the labia majora. For the first three days hot alkaline irrigations (1 dr. of bicarbonate of soda to a pint of water) were given; afterwards twice a day an iodine irrigation (tinct. iodi. 1 dr., aq. ad Oij). Within two weeks the lady was completely free from the anal and vaginal pruritus; the purulent rectal discharge ceased entirely, whilst the vaginal discharge decreased, but did not quite disappear. The

monilias present diminished enormously in number, but did not disappear completely.

Prognosis.—The condition has no tendency to spontaneous cure, but periods of great improvement and even complete cessation of the pruritus may be noted.

Treatment.—This is on the same lines as for mycotic pruritus ani. In uncomplicated cases a salicylic-sulphur ointment or Deek's ointment half strength answers well, or painting with diluted tinct. iodine. When an eczematous dermatitis, generally due to vaginal discharge, is present local applications with lotio plumbi (liquor plumbi sub., 1 dr. to the pint), liquor carbonis detergens (2 dr. to the pint) are useful, and vaginal douching with iodine (tr. iodine 1 dr. to two pints) or potassium permanganate (1 in 5,000) should be carried out. Later tar ointments or pastes such as liq. picis min. 15, zinci ox. 2 dr., vasl. ad 1 oz., are useful. X-ray treatment is at times successful.

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RELAPSING FEVER IN NORTHERN NIGERIA —A STUDY OF 300 CASES.

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THIS disease is a new importation into Northern Nigeria and was first found by Dr. H. Morrison, at Sherafurie, where he was working in the tsetse-fly investigation camp. Ten days later, on March 6, 1924, I found the first case in Kano Native Hospital, in the course of routine blood examinations of new cases that day admitted to hospital. The disease soon became widespread through the north, and to-day, fourteen months after its appearance, it is still exacting a heavy death toll. In November of last year I was sent to Katsina, and my series of cases is made up of 149 from Kano and 151 from Katsina. I have used the first 300 cases for ease in statistical computations, but on April 12, 1925, my total was 321 and I continue to get new cases at the rate of 10 per week. These extra cases are following the lines of the rest, and so nothing is lost by not including them.

Ætiology.—The spirochæte has been measured for me by Prof. Shennan, of Aberdeen, and he reports: "The length varies from 14 to 25 microns. Some are even longer, but they seem to be made up of two end to end. Most of them are round about 20 microns." The body of the spirochæte has anything from seven to twenty-one turns, and wavy, rather than curly, forms are the rule.

In 842 positive blood-films examined, no Balfour "infective granules" were seen either in the spirochætes or in the red blood-corpuscles. Serial films, at one-hour intervals, after injection with neokharsivan, were taken in six cases, and in none was any destruction or granulation of spirochætes seen. The change noticed was an obvious diminution of the spirochætes in each succeeding film. In two cases the spirochætes had disappeared at the end of an hour and the longest time for disappearance was seven hours. Four hours seemed to be about the normal time. The temperature always fell more slowly than the spirochætes disappeared. Seven hours was the average for the fall to normal. The fall always went on, however, to below normal.

Six guinea-pigs were inoculated with whole or citrated infected blood. The dose varied from 1 to 2 c.c. Two of the pigs were one week old and the other four were purchased as adults. In no case was any sign observable, and spirochætes were never recovered in their blood. The two young pigs were inoculated three times each at fortnightly intervals—in all cases with negative results.

One mouse was inoculated with whole infected blood. No spirochætes were recovered twenty-six hours later. Unfortunately this mouse disappeared on the same day and no more mice have been captured alive to carry on this experiment.

One guinea-pig had a drop of infected blood placed in the conjunctival sac of each eye. No result was obtained.

Spirochæta duttoni is inoculable into guinea-pigs, but in no case did I successfully inoculate the spirochæte at present under experiment.

Transmission.—March in Northern Nigeria is in the height of the dry season and very few ticks could be found. I found no *Ornithodorus moubata.*

Pediculus humanus could be collected by the test-tube full from some of the patients, and this was done. The lice were ground up in saline and examined in drop and stained preparations. Spirochætes were found in a stained film after 230 negative examinations. Long before this, however, the absence of ticks, the prevalence of lice, and the finding of infected lice in the Gold Coast epidemic, had made me take precautions against lice. The Native Administration prison in Kano usually contains about 550 inmates, and my first seventy-six cases in the series came from this institution. All new prisoners arrive lice-infested and it was not easy to get rid of the infection in the mud buildings employed.

Eventually the prisoners were lice-free on their weekly inspections, the case-incidence had dropped, but I still got two or three cases per week. A typical search of one cell before de-lousing of its inmates (52 males) gave me 168 lice, 2 bed bugs and 24 mosquitoes. All the lice came from the men, and the bed bugs and mosquitoes from the wall. Later on I could find no lice.

In Katsina there is a prison with 132 inmates, a training college with 43 inmates, and a provincial school with 42 inmates, and these people can be controlled. These three institutions are rigorously inspected, and not one louse has been found by me in five months' searching. Yet I have had 8 cases from

the prison, 4 from the training college, and 1 from the boarders in the provincial school, and 7 from the non-boarders who live in the town.

In these institutions we have people of quite different classes. The prisoners are naturally dirty and they are compulsorily kept clean. In the educational institutions the boys are very largely the sons of the Native ruling class, and they need no compulsion to keep themselves clean.

The absence of lice, and the presence of sporadic cases in these controlled places, suggested a search for the bed-bug. They are present in all Native buildings that I have had searched in Katsina. The people accept lice as a normal feature of their environment, but some have complained of the bed-bugs in the past few months. These bugs live in the mud walls of the houses, come out to feed at night (when they have been caught by me in great numbers), and retire to the crevices in the walls after feeding.

Saline preparations of *Cimex lectularius* have not shown any spirochætes, but twice have I seen a few granules which look like very small lymphocytes which are degenerating. They are fuzzy and the centre stains a pale blue. They are about one quarter of the size of a small lymphocyte and the structure is quite indistinct.

I have not attempted any human inoculation experiments—really the only material available—as there is one type of the fever, which I call the *adynamic*, which has been invariably fatal in my experience, and as I am not prepared to run the risk of acquiring this type, I am unable to ask a volunteer to take a chance.

Examination of bed-bugs is being continued, as I feel convinced that the explanation of the facts in the four institutions under control—the two prisons and the two schools—hangs on the implication of *C. lectularius* as the secondary transmitter of the disease.

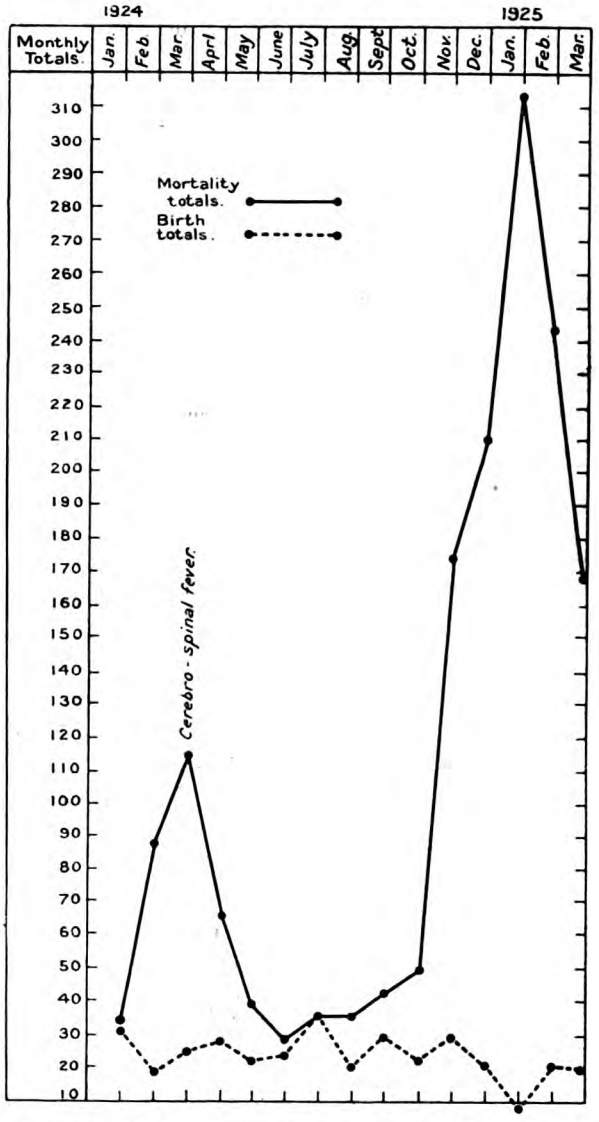
The Senior Sanitary Officer, Northern Provinces, Dr. H. A. Allan, gave me the details of one family in Kano in which 25 died of relapsing fever in a household of 38 within 52 days, 2 men, 2 women, and 9 children remaining. No precautions had been taken against lice or bed-bugs and so that proves nothing as to transmission, but it illustrates the general and very high incidence-rate.

Age and Sex Incidence.—In Kano no children were seen suffering from relapsing fever. The average age of the infected seemed to be about 30 years. There were 145 males and 4 females.

In Katsina 38 children have been seen, the youngest being 8 months old. The average age of the infected seemed to be about 35 years. There have been 20 women and 114 men. These figures as to sex incidence have no significance in a Mohammedan population such as Katsina. The women are the great conservative force in Mohammedan Northern Nigeria and they will not have treatment with Western medicine. The death statistics of the town show an almost exactly equal mortality in males and females. The point is that women keep away from hospital and so do their children.

Extent of the Epidemic.—An approximately accurate calculation can be made as to the numbers involved. Katsina has a reliable system of registration of births and deaths, and the register is submitted to the Medical Officer every month. The names—householder, district of the town and district-head's name—are all inserted in detail, but no cause of death is ever given beyond "Cough," "Fever," "Dysentery"; nor does the Medical Officer certify the cause of death, as there is no compulsory registration.

A graph is appended of the Births and Deaths totals per month of Katsina Town from January 1, 1924, to



March 31, 1925. A review of the statistics available shows the average monthly birth total to be 47, and the average normal non-epidemic death total to be 35.

On September 30, 1924, the census was returned as 18,557 people. The birth-rate was therefore 30·3 per 1,000 and death-rate 22·7 per 1,000.

Relapsing fever reached the town in October and has been here since. Up to March 31, 1925, the excess deaths were 961, and as no other epidemic has been observed and all deaths are returned as "Fever" or

"Jaundice" (see below), I feel certain that all these deaths are due to relapsing fever. The astounding virulence of this epidemic is seen when we realize that the excess deaths for the period October, 1924, to March, 1925, represent 5·15 per cent. of the town's population. In Kano, during my nine months' experience of the disease there, the deaths were at least no less in proportion in a population of some 60,000. In the course of my duties I have visited points 108 miles, 52 miles, and 84 miles away from Katsina, and all in different directions. In all relapsing fever was rampant, with a very high mortality rate. No records comparable to the Katsina records are kept in any of these places, Kano, Malumfashe, Daura or Kazaure, and so the argument must develop by analogy and by the fact that all cases seen by me were undoubtedly relapsing fever, as I confirmed the diagnosis by blood examination on returning to Katsina.

Kano Province has an estimated population of 2½ millions and the disease is widespread throughout its area.

The Katsina mortality of 5·15 per cent. of the whole population is a fact. The mortality percentage has been reduced, because, up to March 31, there had been treated 151 cases in Katsina, of whom only 4 died. It seems conservative, therefore, to assume that the deaths in Kano Province have been at least 5·15 per cent. of the total population, which gives the astonishing total of 128,750 deaths to date. Verily, relapsing fever, the new disease, has assumed the "Captaincy of the Men of Death" by right of fitness for it.

The total deaths for Northern Nigeria will be far more than the above figures. The disease appeared early in Sokoto Province, and I had cases in Kano Hospital who were stricken on the day of arrival from Bornu and Jos. Bearing in mind the fact of an incubation period, these people must have been infected before reaching Kano.

I do not think it possible to estimate the total deaths in Northern Nigeria.

Mortality Rate.—Of those injected twelve died. Six were of the adynamic type which has proved invariably fatal. The other six all died suddenly, maybe because of the injection, maybe because of the grave dilatation of the heart, which is always present in a grave case.

Of 68 cases not injected 32 died—a mortality of 47 per cent. Kano prison furnished 52 of these cases, of whom 30 died—a mortality of 57·7 per cent. The other 16 cases consisted of 6 in Kano and 10 in Katsina, of these 2 died, a mortality of 12·5 per cent. These later cases were kept alive by massive doses of brandy and injections of strychnine, and so do not come into a consideration of average mortality. I believe the prison rate of 57·7 per cent. to approximate to the truth.

Birth Rate.—In Katsina this rapidly fell to 9 in January, instead of the average of over 40 per month in the preceding two years. This fall is explained by abortions of infected expectant mothers, and the deaths of others of them. I refer to this later.

The Blood in Relapsing Fever.—Leishman's stain was used for all purposes of diagnosis, and Giemsa for further investigations.

(*a*) *Spirochætes.*—In only three cases were no spirochætes found during the febrile period, but the blood-picture was typical. Usually spirochætes were present in enormous numbers and often 30 were counted in one field with a $\frac{1}{15}$ in. oil-immersion and a No. 4 C eyepiece. On one day ten positive slides were diagnosed in fourteen minutes, and except for the three negatives I have not had to search longer than ten minutes.

(*b*) *Leucocytosis* is always obviously present from the slide. The average of 62 counts (Zeiss-Thoma hæmocytometer) is 22,862. Three typical counts taken by chance from my notes on the same page are 25,000, 23,437 and 21,456.

In one case (Abeba ♀) a count was done on blood withdrawn about two minutes before death—it was 38,593. The patient was comatose, deeply jaundiced and absolutely collapsed.

(*c*) *Red Blood-corpuscles.*—They almost invariably stain poorly. Anisocytosis is marked, and they show a tendency to clumping. Hæmoglobin by a Talquist paper-test was 68, but I know that the papers were old. The patient's clinical condition soon convinces you, however, that a serious anæmia is present.

The red-cell count varied between 3½ and 6 millions and I did not continue the investigation.

(*d*) *White Blood-corpuscles.* — The blood of a relapsing fever patient passes through four typical phases :—

(1) The POLYMORPHONUCLEAR LEUCOCYTOSIS, when the disease is progressing towards its fastigium, nature is trying to deal with the invader by the use of troops already called up, and they are rushed to the front.

THE MONONUCLEOSIS.—As soon as the fever is well established, large oval cells appear in increasing numbers. In these the protoplasm is clear and translucent; the large nuclears stain very well and may be circular or horseshoe shaped; no granules are present. The cell is about 30 microns in diameter, but some are just larger than large lymphocytes. These cells are leucoblasts. Myelocites and lymphoidocytes also appear in varying numbers, and no attempt has been made to do a differential count of these cells, as all merge one into the other. The drain on the polymorphonuclears has been so acute that nature has to turn out primitive cells to deal with the infection.

(3) The LYMPHOCYTOSIS, when nature rests the storm troops and calls out the scientists to neutralize the poisons of the hiding invading host, an almost certain sign that no further relapse will take place. This picture is occasionally seen in relapses.

(4) The gradual return to normal with transient leucopænia of slight degree.

Chart No. 1 is that of a school-boy, Garba, and his series of slides illustrates the cycle.

Date	Temperature	Total white count	Polys.	Lymphs.	Leucoblast
Jan. 21	98·8	14,000	76	2	22
,, 22	103·8	18,000	52	2	46
,, 28	98·2	—	17	53·5	29·5
Feb. 1	105·4	22,000	34	21·0	45·0
,, 8	97·0	—	58	31·0	11·0

It is to be noted that, on the 30th, Garba had an injection of 0·3 grm. of neokharsivan and that on February 1 he had an alarming relapse. The blood-picture promptly reacted to the renewed stimulus as seen from the chart (p. 338).

A typical count of a case, treated symptomatically, on discharge from hospital is :—

Polymorphs	...	37 per cent.
Lymphocytes	...	60 per cent.
Leucoblasts	...	3 per cent.

The difficulties of a differential blood-count were well illustrated by the following case.

First count 200 cells :		Second count 200 cells, at edge of same film :	
Polymorphs ...	23 per cent.	Polymorphs ...	20 per cent.
Lymphocytes	66 per cent.	Lymphocytes	0 per cent.
Leucoblasts ...	11 per cent.	Leucoblasts ...	80 per cent.

The count done on the duplicate slide worked out as follows :—

Polymorphs	...	22 per cent.
Lymphocytes	...	43 per cent.
Leucoblasts	...	35 per cent.

Since then I have never counted near the edge of a film nor have I counted less than 500 cells for the purposes of this paper. As would be expected, no lymphocytosis occurs after injection. The stimulus for the production of antibodies has ceased, and so none is produced.

A typical count in the injected on leaving hospital is :—

Polymorphs	...	84 per cent.
Lymphocytes	...	12 per cent.
Leucoblasts	...	4 per cent.

and it soon rights itself.

Malaria in Relapsing Fever Blood.—The average native blood-film shows malaria pigmentation, no matter for what disease the patient is admitted, but in relapsing fever this pigment disappears. I have not seen a case of malaria running concurrently with relapsing fever, although in one case *Plasmodium falciparum* rings were found in the blood during what I thought was a relapse ; no spirochætes were present. Quinine administration promptly stopped the fever. In relapsing fever the polymorphs present are usually very small thus showing that they are the children of overworked parents, and the point I want to make is that a lot of malarial pigment has disappeared from the blood and has presumably been stored in internal organs. The cerebral and cardiac symptoms can as easily be explained by the deposition of masses of pigment as by the clumping of spirochætes. Probably the two conditions are co-existent.

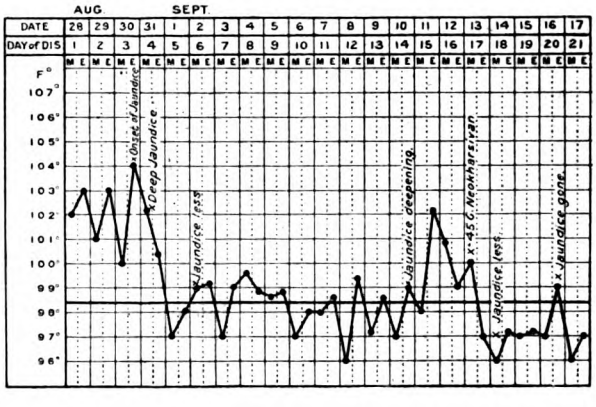
The Arneth count was of no use in prognosis. In the large majority of admissions with fever the count was around 56, and when it sank to 30 the patient was already so ill, clinically, that confirmation of his critical condition by this method would be merely academic. The range was from 78 to 29. I have not been able to interpret the results in any useful manner, and I have discontinued these counts.

Urine.—The urine was usually highly coloured and acid, with specific gravity 1010-1019. In 90 per cent. of all cases bile was easily recognizable. Albumin occurred in 12 cases not of the adynamic type, and was always a grave sign. Neokharsivan is not contra-indicated. Neither blood nor casts were found in any deposit. One of these patients died and all the others occasioned anxiety for some days.

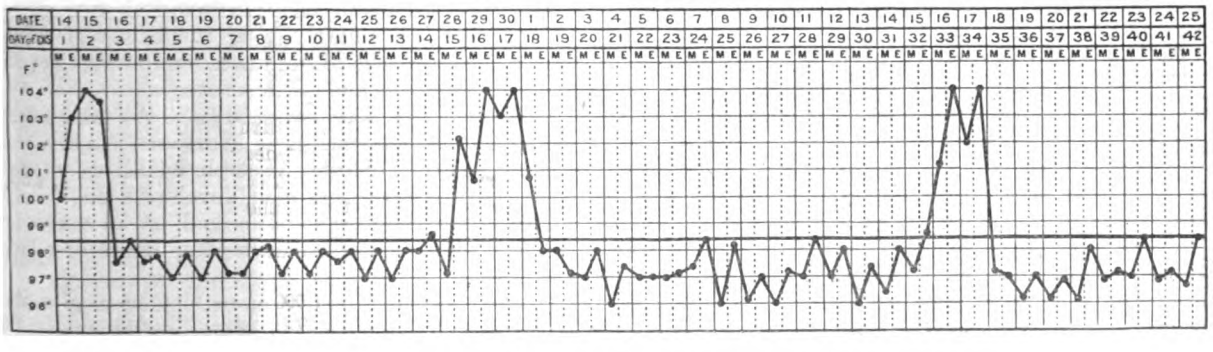
Post-mortem findings.—The Native objection to this examination determined me to do none.

Clinical Features.

Incubation period.—One of my nurses (Chart No. 3), went down with the disease on August 28. I have no



doubt that he had been infected in the observation ward, where new admissions were de-loused. His wife (Chart No. 4) went down with the fever on



September 15. As the period of non-infectivity of the louse is eight days [2], that leaves an incubation period of anything up to nine days—if the bed-bug had nothing to do with this case. A very careful search of the house and of its inmates by myself revealed no lice and only one bed-bug on a native bed.

Prodromata.—This period lasts about sixteen hours. Always the first sign is intense frontal headache, which works up in a crescendo and totally incapacitates the patient. About twelve hours after the onset of headache there is commonly a sharp rigor—one in hospital lasted fifty-five minutes and showed a marked increase of blood-pressure during the period. The temperature cannot be taken at these times, but, in this case, at the end of the rigor the temperature was 100° F.

The presence of bile in the urine is so constant a feature of the disease that I examined the urine of several cases who came to the out-patients' department complaining of headache. Two cases of many that were positive to methylene blue and sulphur came into hospital, and one is the case of rigor already described. The other had a rigor lasting ten minutes. I now regard bile in the urine as an important prodromal sign; and 11 admissions to hospital, with bile in the urine and frontal headache, have all developed relapsing fever and so have been treated within two hours of the onset of fever. The other curious point is that all these cases developed their temperature between 6 and 8 a.m. No case developed jaundice.

The Fever.—Within four hours of the rigor the temperature is anything up to 105° F. The pulse is fast and bounding; the respirations preserve their ratio to pulse, and great pain is complained of in 45 per cent. of cases in lumbar region, thighs, and only in a few cases shoulders. Any food eaten that day is vomited.

In 4 per cent. of the cases the vomiting continues and is soon bile-stained. Diarrhœa sets in with the rise to a high temperature in 21·3 per cent. of the cases. In the majority, however, constipation is the rule. I tried to establish a relation between diarrhœa and cyst-passers, but constipated patients showed just as high a percentage of flagellates and *Entamœba histolytica* cysts. There is probably some relation to ankylostome infection, however, as thirty-two of the sixty-four diarrhœa cases showed ova without any special attempt at concentration of the eggs.

On the second day the patient is obviously very ill and the highest temperature is usually reached that evening.

On the third day the fever usually ends by crisis.

The longest pyrexia observed lasted five days (1 per cent). A pyrexia of four days occurred in 3 per cent.

Jaundice has been present in 70 per cent. of all cases and 92 per cent. of the untreated. It starts on the third day usually and is perfectly obvious within five hours of onset.

It remains stationary, if the patient is doing well, from the fourth to the sixth day, and then starts diminishing. Most cases are free in ten days from onset.

Liver is often tender but enlargement is very variable. Tenderness is a bad sign if injection is withheld.

Spleen.—The spleen was tender in 13·3 per cent. of cases. Enlargement is of course constant (malaria), but in *all* cases diminished under neokharsivan treatment, as did the few enlarged livers encountered. Splenic tenderness seems to be an important point in the diagnosis.

Heart.—In cases of good reaction (high temperature) the pulse never occasions any anxiety. On the second day some dilatation is obvious but compensation remains good. This dilatation is practically universal and is the cause of the grave weakness during convalescence.

Epistaxis occurred in 17·3 per cent. of the cases. It is always very copious and shows a great tendency to recurrence. It may come on at any period up to three days after injections of neokharsivan. Even one hæmorrhage, although promptly controlled, seems to set back the patient's convalescence several days. It is a sign which causes anxiety.

Hiccough is a bad sign, but only two cases who had it died out of twenty-six. It cannot be regarded as a sign of impending dissolution, although it is extremely intractable. In most cases it lasted for three days in spite of all known attempts at treatment, short of injection of the phrenic nerve, to which I could find no reference.

Relapses.—The most common period of apyrexia was nine days. The shortest period was five days and the longest thirteen. Only one case was seen which had two relapses, but several patients told me that they had two relapses before they came to me for a tonic. None of these had further relapses, so far as I know. The relapse was usually very similar to the primary fever. In almost equal numbers of those who had relapses differing from the primary fever the temperature was higher or lower than the first attack. But in none were the symptoms so severe.

Complications. — *Malaria and dysentery* have occurred immediately on onset of convalescence. Malaria has occurred only twice, but dysentery has been left in possession on six occasions.

Ankylostomiasis may have to do with the diarrhœa of some cases. A heavy infestation means a poor convalescence until the patient is sufficiently strong to have anti-helminthic treatment.

Bronchitis is so common that it may be regarded as a symptom of the disease. It is usually mild.

Pneumonia.—One case in hospital died of lobar pneumonia immediately after the crisis of relapsing fever. Six cases of broncho-pneumonia developed before the crisis and all recovered.

Pleurisy was seen seven times. As tuberculosis is prevalent in the natives of Northern Nigeria this is not to be wondered at. Tubercle bacilli were found in three sputa, and one man developed acute miliary tuberculosis and was discharged to be taken home to die. He died one month after onset of relapsing ever.

Iritis occurred in five cases. One case went on to phthisis bulbæ in spite of vigorous treatment. The other cases recovered without incident.

Stomatitis occurred in a large percentage of those treated in their houses. This is not a sign of relapsing fever, but merely conditioned directly by the absence of nursing and of the most elementary ideas of cleanliness.

Laryngitis occurred in twelve cases with aphonia in one.

Nervous Involvement.—Aphonia was present three times. The throat condition seemed normal. I was unable to get a view of the vocal cords as the patients were not in hospital.

Ptosis of the upper lid occurred twice.

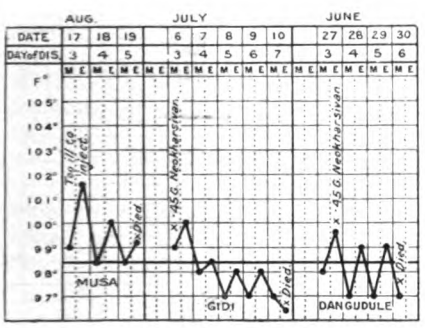
Diplopia was seen once.

Delirium occurred three times in hospital and all cases died. They were very violent, always noisy, and all three died suddenly from cardiac failure, two on springing out of bed.

Coma was seen in all adynamic cases, but in no others.

Note on Adynamic Cases.

See Chart No. 5 where three tracings are shown. These cases differed from the rest in the absence of reaction to the infection. The temperature was always low in comparison with the majority of cases, and the heart was always extremely dilated.



The pulse was usually uncountable and most irregular.

Jaundice was always intense and the patients were never sensible when I saw any of them. Relatives always told me that they had fever for "about a day."

All cases sank into coma apparently within forty-eight hours of the onset of the illness. Injections had no effect on the result. The blood-count of Abeba —38,593—illustrates the delirium of blood production that goes on. This case is thus recorded in my notes: "October 21, 1924, Abeba, female, admitted absolutely collapsed; temperature, 96° F.; pulse 70, going up to 124 whilst being taken, then uncountable. Extreme jaundice of all mucous membranes. Brandy, 1 oz. statim; strychnine, $\frac{1}{100}$ gr. statim. Died before leaving bedside after taking slides and hæmocytometer blood. No history available as she was brought in by sanitary staff."

The differential count was as follows:—

Polymorphs 65 per cent.
L. lymphs 5 per cent.
S. lymphs 13 per cent.
Leucoblasts 17 per cent. Arneth index 50

The notes continue: "Microcytosis of the polymorph is extremely marked. There is either great immaturity (?) or degeneration (?): so much so, that the nuclei can with difficulty be distinguished in most of the cells: they seem to fuse with the rest of the cell, i.e., diffuse finely granular pigment. There is extreme increase of the platelets, whole fields being blotted out by their vast numbers. Death occurred two minutes after blood-film was taken however." The difficulty of distinguishing the cells makes the above differential count of no value. I am now inclined to believe that these cells were myelocytes of a very small variety.

In a second case, Dangudule, the total count was 28,000, and the differential count:—

Polymorphs ... 52 per cent.
Lymphs ... ... 17 per cent.
Leucoblasts ... 31 per cent.

The staining was again poor but more definition was obtainable. The "leucoblasts" really means "mononuclears," as a lot were myelocytes. I have had ten of these cases and none reacted to any treatment. As the blood-picture is markedly different from the "normal" cases, in the extreme microcytosis and the total numbers, it seems that the crux of prognosis is the staining reaction of the cells, this again depending on the degeneration, or immaturity, of the cells in the blood.

Stitt [3] mentions the "bilious typhoid of Greisinger" in Egypt, which is characterized by great tenderness of the liver, marked bilious vomiting, *late* jaundice, albuminuria, joint pains and a high death-rate. Many cases of adynamic relapsing fever were always too ill to give any symptoms, so that presence of pain could not be easily elicited. The liver was certainly tender, as was the spleen, in all cases, but rough handling only elicited movement or groans. Both organs were always enlarged. The jaundice was always *early*, however; albuminuria was present in six cases (not included in the others already cited). Spirochætes were seen in nine of the ten cases; but only after careful search. It seems to me that Greisinger's cases belonged to this type of relapsing fever, but I have not seen his report, and Stitt's note is the only reference to it that I know.

Diagnosis.—Epidemic jaundice and yellow fever had to be excluded at first. The response to the infection by rise of temperature, and corresponding pulse-respiration rise, were hopeful signs. The presence of the spirochætes and the immunity of guinea-pigs settled all my doubts. The early jaundice and rapid recovery of a patient after the crisis are important points. There was never any "coffee-ground" vomit, and the only hæmorrhages were from the nose. The effect of neokharsivan was always dramatic. The sense of well-being, however, is usually succeeded by depression owing to the weak anæmic state of the patient.

Dark-ground illumination has not revealed any spirochætes or spironemata in the urine of any of the 22 cases examined. This method of examination is being continued.

Prognosis.—A high temperature means a good

reaction and a safe convalescence later on. If the temperature goes up to 105° F. you have no worry; but if it remains round about 100° F. there is grave danger. Cardiac dilatation is practically universal, and it must be watched. As all febrile patients, except the delirious, are too ill to want to leave bed, sudden death should be easily guarded against.

It is to be noticed that a good pulse alone is no safe prognostic sign. One is guided by the temperature and the blood-picture. In one hour I have seen a good pulse become uncountable.

Immediate treatment gives the proper prognosis—recovery in all cases, practically speaking.

Treatment.—An intravenous injection of neokharsivan is given as soon as the diagnosis is made—provided there is any fever. I found that 0·45 grm. is the proper dosage for the vast majority of cases, and 0·6 grm. for very big men; 0·3 grm. does not cure. For purposes of cure it does not matter at what time of the febrile stage the injection is given, but the time of injection does affect the convalescence.

Patients injected on the day of onset have a much shorter convalescence than those injected near the crisis. Injections given during an afebrile period merely make the relapse of a milder type.

In collapsed cases, with a high temperature, I have been giving $\frac{1}{100}$ gr. of strychnine hydrochlor. mixed in neokharsivan solution with good effect. In two adynamic cases I tried this treatment, but it seemed to have no effect whatever.

Symptomatic Treatment.

High Temperature.—My first case of 105·4° F. was promptly sponged, and he as promptly reacted by developing broncho-pneumonia. The temperature had been reduced to 101·2° F., when manipulations were suspended, and twenty-four hours later he was extremely ill. Fortunately he recovered. Since then I have left all attempts at rapid reduction of temperature severely alone. I give brandy, ½ oz., every hour and push it until the temperature falls. I do not inject neokharsivan at a temperature above 104·6° F. without strychnine, as the induced crisis causes an acute collapse. In the only case which I injected at 105° F. the temperature dropped below the register of the thermometer.

Collapse.—All cases must be watched after injection to see that the rapid crisis does not cause collapse. Brandy and, occasionally, hot-water bottles are unfailing preventives.

Hiccough.—Posture does not help. Tinct. iodi. mits. 3 minims two-hourly, controls some cases; turpentine, 1 oz. in mucilage, controls others. Most go on for three days and then stop. I always order digitalis, 10 minims q.i.d., if there is no temperature during the bouts; I think it prevents some of the exhaustion.

Epistaxis.—Packing with adrenalinized gauze has been of use. The most useful treatment is mopping and the continuous snuffing of tannic acid.

Pneumonia.—The following mixture has proved specific in my hands both in relapsing fever cases and in the others. I am indebted to Dr. Clive Sharp, of the West African Medical Service, for the formula:—

℞	Alcohol	... ...	2 dr.
	Liq. ext. glycy.	...	3 dr.
	Creosote	... ...	½ dr.
	Pot. iod.	... ...	2 dr.
	Aq. ad	... ...	12 oz.

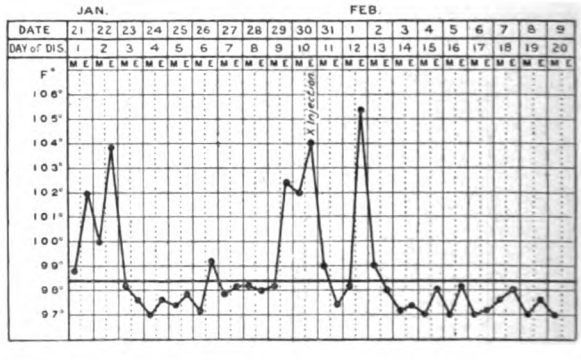
One oz. t.d.s., add 1 dr. of ol. morrhuæ to each dose as ordered. I prescribe 1 oz. every two hours until irritation by the creosote is obvious, then give it every four hours. The chest is swathed in cotton wool and antiphlogistine, when I have it.

Dysentery carriers are treated during convalescence with E.B.I.

Ankylostomiasis is treated during convalescence.

Some Special Cases.

Garba, schoolboy, aged 13, Chart No. 1, is the same case as that discussed under blood-pictures. He illustrates the tendency, met with five times, for a disquieting rise of temperature to occur after injection. He was given 0.3 grm. of neokharsivan on January 30, and his temperature was normal all next day. On February 1, I was sent for at 10 p.m. as he



was extremely ill. His temperature had shot up from 98·6° F. at 6.30 p.m. to 105·4° F. His pulse was very good, but he was confused and talking of going home. Brandy, 1 oz., was given immediately and a special nurse put on. At 11 p.m. his temperature was 104·2° F., and I left the hospital. Next morning at 7 a.m. his temperature was 99·0° F., but he was very weak. A blood-film was taken at 10 p.m. on the night of February 1, and examined the next day. There were large numbers of spirochætes, which were the longest I have seen. It is the only slide which showed these organisms with 18-21 turns, and a slide at 7 a.m. on February 2 was negative. He made an uninterrupted recovery and was discharged back to the school on February 9 as I wanted his bed. Being at school, he remained under control. He has been quite fit since.

Kande, aged 30, wife of the nurse who got infected. Her chart is remarkable as the only one which showed two relapses. She refused injection and had only symptomatic treatment. Her illness was further remarkable for the great regularity of her three temperature curves, and the thirteen-day interval between her two relapses.

Her blood-picture was the first one which made the periodicity perfectly clear to me, as I had serial films taken for forty days. The film of September 15 showed a polymorphonuclear leucocytosis of 82 per cent. and that of October 25 a lymphocytosis of 68 per cent. In the afebrile periods the picture always showed a lymphocytosis being rapidly established, to be partially changed into a leucoblastosis in the relapse.

A Suggestion as to the Bionomics involved in this Epidemic.

There are several complex variables to be considered in any epidemic. In this one we must consider the environment of the human host, his resistance to infection, and the reaction which he is exhibiting to this new invader. We must also consider the conditions that obtain in the environment of the insect-host, its distribution and the extent of infection by the spirochæte. Further, we must consider the virulence of the causal organism and its power of "seeding" the population.

The environment of the people is bad. They live in houses constructed of mud, which have walls at at least one foot thick. There is never more than one window to a room, and it is very high up and only one foot by six inches in area; the doorways are usually about five feet by two feet, and often less than this.

The staleness and warmth of the atmosphere have to be experienced to be realized. There is never enough light to see a patient, and a lamp and a cigarette are always lighted before entering a native room.

The population is Mohammedan and so polygamous: this leads to overcrowding in the sleeping rooms, except in the houses of the better classes.

Water is scarce in the North, and the average native carries out only his ceremonial ablutions, which do not affect the lice on his body. In every way the ideal nidus for the louse is ready.

The resistance of the people is generally admittedly poor to all epidemic diseases.

The people are reacting to this infection by a primary leucocytosis and a secondary lymphocytosis. I believe that this has a special significance, which I shall discuss at some length.

The louse is not new to these people. It is a normal factor in their environment. The epidemic reached its peak in Katsina in January, which was the coldest month for forty years, according to the natives. For an insect-borne disease this seems very strange; but it is explained by the habits of the native in cold weather. He lights a fire in his house and sleeps near it. There is no attempt to ventilate the room, as the window and doorway are blocked up with mats. The temperature rises above the summer room-heat, as I have proved. The louse is not incommoded and it lives its normal life. The condition seems to be exactly comparable to those obtaining during typhus outbreaks in Russia during the winter.

The spirochæte is widely distributed through the North. It shows quite extraordinary virulence, as the death-rate of the infected is apparently about 57·7 per cent. The power of "seeding" the population appears to be high, as the adynamic cases have very little power to react, if any at all.

This new disease has invaded the country probably along several trade routes, as a reference to the map will show the difficulty of explaining otherwise the early widespread nature of the epidemic in far-away Sokoto.

The distribution and virulence of the spirochæte are both excessive; yet the disease seems to be reaching a state of equilibrium, as all epidemics do sooner or later. Why is this? The reason is the active immunization of the survivors of an attack, and the consequent drying up of reservoirs of the virus upon which the louse can draw. But I believe that I am watching more than that. I believe that I am watching the immunizing of a large part of the new generation.

I turn to my text-books and look up the discussion of immunity in the various diseases. All discussions bristle with "possibly," "it would appear," "it is probably explained," and I was struck with the idea that biological explanations are not invoked in an attempt to explain the facts. For instance Stitt [4] states, in the discussion of yellow fever, that "as proof that such immunity is not racial we may note that in Ecuador the natives of the endemic area about Guayaquil possess an immunity due to mild attacks in childhood; but the natives of Quito, 300 miles distant, where there is no yellow fever, do not possess it." As the disease is absent from one of the places compared, there is clearly something different in the environment. It seems to me that you cannot compare the reaction of two populations, one of which has had experience of the test object, while to the other it is entirely new. We should never talk of racial immunity until we know that the whole race lives under the same conditions environmentally with regard to a particular disease. To know this we must know the bionomics of the cause, of the insect host (if existent) and of the people.

The power to react to infection is inherent in all human beings. In this epidemic we see that the final, winning reaction is the production of antibodies. Now the infant is born with a polymorphonuclear leucocytosis, but a mild attack of an acute infection will quickly change the picture into a lymphocytosis. This is then the most primitive mode of fighting infection.

Relapsing fever has attacked a non-immune population in Nigeria. The environment of the people does not help them, and it is a war of primitives.

If ontogeny recapitulates phylogeny, it cannot be fortuitous that the infant's reaction is being repeated in this new disease. The Nigerian native is showing us man's primitive reaction.

Speaking biologically, the only reason that the attacked survive is to hand on their spark of Life. The two pregnant women whom I had in hospital were brought in because of threatened abortion, and both did abort. But I have treated convalescent expectant mothers who had recovered from the disease and

needed only a tonic. Unfortunately I did not make a blood-count or a differential count, as I had not yet formulated any opinions about immunity. No doubt these women reacted as all other uninjected cases did, by the rapid production of antibodies via a lymphocytosis.

The child *in utero* during the mother's illness will be born with the tendency to react to infection in exactly the same way that his mother has recently reacted. The antibodies in the mother's blood must have passed into the child's circulation, and I think it fair to presume that this pouring in of antibodies is bound to pull the trigger of the inherited tendency to produce still more antibodies. That means that the immunity of the infant is composed of two factors. The more immediately important is the passive immunity from the mother; the more ultimately important is the active immunity developed in response to the maternal danger signal.

The passive immunity may explain the remarkable immunity of the infant up to his sixth month from most of the infectious diseases. It is then exhausted, and, provided an infection is sufficiently heavy, the child has not enough active immunity to combat infection successfully.

We accept the conception of the survival of the fittest, and it seems to me that nowhere does this conception help more than in the organism's recovery from disease. It is inconceivable to me that the human organism can pass through such a crisis as it does in this epidemic without the impress being left on every tingling cell. The successful reaction must be recorded by nature, and its perfection, hereditary absolute immunity, is slowly built up by minute accretions from generation to generation. We must remember, however, that the very essence of the process is the continuance of the stimulus of antibody production; of course by the continued presence of the particular pathogenic organism.

Immunity is "racial" to trypanosomiasis in the game animals of Nigeria. Who can say that this immunity is extended to those animals which are not in a tsetse environment?

Stitt's example of yellow fever proves my point. Immunity is not racial, but an immediately heritable property which will appear racial when the process has gone on for an enormous period of time, provided that the whole race is in the same environment for that period.

I think that I have read of a tribe losing its immunity to some disease, but I have no reference to it in my notes. That is a process which I should expect to happen, as I believe immunity to be a character which is still being moulded by nature.

The text-books are very prone to postulate "mild attacks" of an illness in childhood to explain an adult immune population. They are quite right so far as they go, in my experience of malaria, but why should the attacks be mild? This is not explained.

The European comes to Nigeria a physically fit man. He is armed with mosquito boots, mosquito net, quinine, doctors to advise him and to keep the station clean; and yet he gets malaria. His first attack is usually a sharp one and he is temporarily an ill man. The native baby in the Niger delta arrives and is kept naked in a house set in a tropical swamp. The infant death-rate in Lagos, which is in the middle of numerous creeks, is 242 per 1,000. If we assume the infant mortality rate in the swamps to be half as much again, which I am assured is an excessive estimate, that means that six children in ten survive where a European, fully grown and fully protected, cannot live. Why do not all infants die? I can see no possible reason if it is not that they inherit a partial immunity to malaria. It is to be remarked that in these Southern pagan tribes it is the rule to starve the newly born for at least 48 hours, and some tribes extend the fast to as long as 96 hours. The effect on the child, who has just changed his environment more completely than it can ever be changed again, must be colossal.

These tribes, as far as is known, are holding their own; with the solitary exception of one which is disappearing under the influence of syphilis.

The Northern Hausa is to-day in exactly the same position with regard to relapsing fever as the European with regard to malaria. Neither has any inherited immunity to their new infection, and they must rely on their individual power of developing active immunity.

If the stimulus to immunity is persistent, from generation to generation, the immunizing process will go on to posterity, and the children will have "mild" attacks of disease, so that their passive inherited immunity and their active acquired immunity will in time create an insusceptible adult population.

It should be pointed out that every time that a case of relapsing fever is injected a biological offence is committed. The artificially cured cannot hand on his resistance, and we cannot tell what price his descendants will pay.

Summary of Paper.

(1) *Relapsing Fever* came to Northern Nigeria for the first time early in 1924.

(2) *The Spirochæte* is carried by the body louse, and possibly by the bed-bug as well.

(3) *The Spirochæte* is probably not *S. duttoni*. It corresponds more to *S. recurrentis* in the clinical course of the fever; in its non-pathogenicity to guinea-pigs, and in the absence of *Ornithodorus moubata* as a host.

(4) A clinical entity, the adynamic type, is superficially very like yellow fever, and it is probably identical with "the bilious typhoid" of Greisinger, in Egypt.

(5) The general *mortality rate* appears to be about 57·7 per cent., and probably more than 5·15 per cent. of the total population of Kano Province has been wiped out.

(6) Neokharsivan is specific, and, apart from adynamic cases, the mortality should not be more than 1 per cent. for all treated cases.

(7) The rising of the depressed birth-rate and the drop in monthly incidence of cases points to an active immunizing of the population, the most impor-

tant factor being the immunizing of the children *in utero*.

(8) This inherited immunity is passive. It explains the "mild" attacks in childhood which lead to an immune adult population, as regards any long-established endemic disease.

(9) The term "racial immunity" has tended to lead to confused thinking, as the all-important factor, the continued presence of the stimulus, is usually neglected.

(10) Therefore, immunity is most usefully regarded as being an immediately heritable property, which will become racial, if the whole race continues to live in the same environment as regards the particular disease.

I am deeply indebted to Dr. Connal, Director of The Research Institute, Yabba, for his constant willingness to supply me with stains, media and apparatus.

The Director of the Medical and Sanitary Services, Nigeria, has kindly granted me permission to publish this paper.

REFERENCES.

[1] CASTELLANI and CHALMERS, "Tropical Diseases," p. 932.
[2] MANSON, "Tropical Diseases," 1923 edition, p. 176.
[3] STITT, "Diagnostics and Treatment of Tropical Diseases," 1922 edition, p. 92.
[4] *Idem, ibid.*, p. 105.

The Cultivation of Endamœba histolytica (William J. Boeck and Jaroslav Drbohlav, *American Journal of Hygiene*, July, 1925).—Two strains of endamœba were obtained in culture from two cases of amœbiasis, and were found to be morphologically identical with the endamœba in the fæces of the patients and with *Endamœba histolytica*. One strain, "K," was grown in cultures for eight months and eleven days, and another, "E," for three months. The most suitable artificial environment for the growth of *E. histolytica* was in either the Locke-egg-serum or the Locke-egg-albumin medium, at a temperature of 37° C. An initial reaction of the medium pH 7·2-7·8 was necessary. The cultivation experiments demonstrated that *E. histolytica* may, in the absence of a diet of tissue juices, extracts and red blood-cells, eat bacteria. Both strains, isolated in cultures, proved to be pathogenic for kittens, in which they produced acute dysentery, colitis and, in two kittens, a liver abscess. Prolonged cultivation did not influence the virulence of the amœbæ. The work reported by Cutler (1918) with respect to the cultivability of *E. histolytica* is confirmed by these experiments, but it was impossible to produce encystment under the conditions through which Cutler claims to have brought it about. The media used proved to be more suitable for the multiplication of *E. histolytica* than the blood-bouillon medium. Encystment occurred in a culture of the "E" strain of *E. histolytica* on one occasion only. The Locke-egg-serum and Locke-egg-albumin media have proved suitable for the cultivation of *E. histolytica*, *Chilomastix mesnili*, *Trichomonas confusa*, *C. gallinarum*, *T. gallinarum*, and has maintained *E. coli* and *Endolimax* for a period of three days.

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THE JOURNAL OF

Tropical Medicine and Hygiene

SEPTEMBER 15, 1925.

THE HAYLING BRITISH MOSQUITO CONTROL INSTITUTE.

SOME five years ago the inhabitants of the central residential area of Hayling Island found it impossible to sit in their gardens in the late afternoon during

the summer and autumn. This was owing to the mosquito nuisance which had been increasing year by year, and had become intolerable. To combat this nuisance Mr. John F. Marshall, M.A., F.L.S. and F.E.S., assisted by Sir Richard Gregory, editor of *Nature*, founded the Hayling Mosquito Control Committee, which was the first organization in England to attack the mosquito from the " nuisance " point of view. The first task of the Control Committee was to discover what species of mosquitoes were the chief offenders, and for that purpose several thousands of mosquitoes were caught within the central residential area and identified. This preliminary research made by Mr. J. F. Marshall disclosed the interesting fact that practically the entire mosquito nuisance was caused by one particular species, namely, *Ochlerotatus detritus*, which breeds in brackish water.

Further investigations proved that the breeding places of the larvæ of *Ochlerotatus detritus* were about a mile and a half distant from the centre of the main residential area; that they were present in large numbers in stagnant salt or partly salt water; that the larvæ thrived not only in brackish water, but also in pure sea water, provided it was stagnant; and that the " hatching out " season of *Ochlerotatus detritus* was abnormally long in comparison with that of other British mosquitoes, the adults being produced continuously from March to November. Measures based on these facts were gradually introduced, and with the abolition or control of the principal accumulations of stagnant salt water the nuisance was successfully dealt with. The result has encouraged neighbouring sea coast district authorities to seek advice and guidance from Mr. Marshall to rid them of a similar mosquito nuisance. It was necessary for the advancement of the work that there should be a mosquito control laboratory and museum, and these were provided by Mr. Marshall in his house. But now, in view of a scheme of research on a wider basis, and the need of provision for practical training of students and others likely to be engaged in mosquito control, Mr. Marshall has had built at his own cost a fine institute called the Hayling Mosquito Control Institute and equipped it. This institute was opened on August 31 of this year by Sir Ronald Ross, Director-in-Chief of the Ross Institute and Hospital. There was a large attendance of members of the British Association and of residents on the island and neighbourhood. Sir Richard Gregory, who presided, said it was one of the glories of British science that some of its best work had been done by non-professional workers—men who had taken to the study of Nature purely for the love of it, and that the British Mosquito Control Institute was the outcome of work of that kind conducted by Mr. Marshall. In glowing terms he also described the results which had in the course of time followed the epoch-making discovery of the transmission of malaria through the anopheline mosquito by Sir Ronald Ross, whose work had placed Sir Ronald among the benefactors of mankind.

Sir Ronald Ross, in an interesting speech, said that when he began his work in India thirty years ago he could not obtain a single book or even a good article on the subject of mosquitoes of that country. Now they possessed much knowledge on the subject. But more energy was needed to act upon this knowledge. The work already done against disease caused by mosquitoes was only the beginning. The ultimate aim was to control not only mosquitoes, but all the dangerous and unpleasant pests which affected human beings and their crops and herds everywhere. After alluding to the objects of the Institute he remarked that mosquito control here would facilitate mosquito control in the most pestiferous regions of the earth, and the day might come when all those fertile tracts of the world now dominated and ravaged by King Malaria and King Mosquito would be laid open to civilization.

A vote of thanks to Mr. Marshall, proposed by Mr. T. Regan, President of the Zoological Section of the British Association, seconded by Colonel James, of the Medical Department of the Ministry of Health, brought an interesting ceremony to a close, and the three hundred guests had the opportunity of inspecting the Institute, which contains a demonstration museum, a laboratory, drawing and record offices, photographic rooms, a mechanical workshop and rooms for research workers.

S.

Annotations.

A Buffered Solution for Perfusion of Isolated Organs (R. N. Chopra and Sudhamoy Ghosh, *Indian Journal of Medical Research*, July, 1925).—Ordinary Ringer's solution and Tyrode's solution are unsuitable for perfusion of isolated organs, on account of the wide range in the variation of their hydrogen-ion concentration under experimental conditions (temperature of 37° C. to 40° C. and constant bubbling of oxygen). Variations in the hydrogen-ion concentration of Fleisch's solution are so small as to be negligible under experimental conditions. Fleisch's stock solution keeps indefinitely in a paraffined bottle in tropical climates.

Some Observations on Normal Sugar-Content of Blood and the Sugar Tolerance Test (S. L. Bhatia and G. Coelho, *Indian Journal of Medical Research*, July, 1925).—Blood-sugar was estimated in thirty-eight normal subjects, of whom eighteen were those who lived on a " mixed " diet, and twenty were pure " vegetarians," partaking of large quantities of carbohydrates. In the former class (non-vegetarians) the average blood-sugar was lower, tolerance for carbohydrates greater, and glycuresis less common than in the latter (vegetarians). The significance of these differences in the two classes of individuals is discussed.

Monilia Psilosis Ashford in Severe Anæmia associated with the Sprue Syndrome (Lawrence Weld Smith,

Philippine Journal of Science, April, 1924).—Eight cases of severe anæmia associated with the sprue syndrome were dealt with, and the *Monilia psilosis*, Ashford, 1914, was isolated from these cases, this being the first time it has been reported from the Philippine Islands. The specific nature of the complement fixation in sprue, using a watery extract of *M. psilosis* as antigen, was discussed. The histopathology of the peripheral blood was described, and on the basis of the blood-picture this anæmia was tentatively classified as aplastic.

Microbic Virulence and Host Susceptibility in Paratyphoid-enteriditis Infection of White Mice. The Effect of Selective Breeding on Host Resistance (Leslie T. Webster, M.D., *Journal of Experimental Medicine*. July 1, 1925).—The survivors of an experimental mouse typhoid infection, selected and bred for a number of consecutive generations, give birth to offspring which are more resistant to the disease than a random group of the same inbred race. The offspring of females most susceptible to this infection give birth to individuals which are more susceptible than a group of similar unselected mice.

Observations on the Possibility of Cure of Syphilis in Rabbits with Arsphenamine (Alan M. Chesney, M.D., and Jarold E. Kemp, M.D., *Journal of Experimental Medicine*, July 1, 1925).—The authors find that it is possible to treat syphilitic rabbits in such a manner as to render the lymph nodes incapable of transmitting infection to normal rabbits. The treatment should be begun either early or comparatively late in the course of the disease. If early, the animals are almost certain to be infected a second time, but if the treatment is begun late, they are almost uniformly refractory to a second infection. This refractory state in rabbits may possibly be explained by the existence of an acquired immunity which persists after the abolition of the disease, more than to the continuance of the first infection. It seems, under certain conditions, possible to reinoculate rabbits and, without producing any lesion at the portal of entry, produce generalized infection.

Biochemical Study of Resistance to Mildew in Oenothera (Joaquin M. Maranon, *Philippine Journal of Science*, April, 1924).—In order to discover whether or not there were definite correlations between chemical composition and reaction to mildew, chemical analyses were made of several resistant and susceptible hybrids and elementary species of *Oenothera*. These analyses were extended to other plants which had strains resistant and susceptible to other forms of powdery mildew. The resistant strains are higher in tannin and water-soluble acid, and in the majority of cases they are also higher in crude fibre than the susceptible ones. The susceptible strains are comparatively high in total nitrogen and total ash. The forms of nitrogen that are high in the susceptible strains during infection are the amino acids and nitrogenous compounds of non-basic character. The leaves of the susceptible plants are very rich in protein nitrogen when the plants are approaching senility. As compared with that of the resistant plants, the ash of the susceptible plants is exceedingly high in calcium and sulphur. The same correlation of chemical composition with disease resistance was found in all the strains examined, which comprised wild elementary species, reciprocal hybrids and mutations. Differences in chemical composition are found in both resistant and susceptible strains, before infection and after, and during the period when the leaves show chlorophyll degradation, indicating that the characteristic features of these two strains are constitutional. The chemical analysis made of the susceptible and the resistant plants of *Syringa vulgaris*, *Desmodium canadensis*, *Helianthus giganteus*, and *Solidago canadensis* confirms the findings in regard to *Oenothera*. An exception was found in the total ash and water-soluble acid contents of *Helianthus giganteus*, but the plants were wild and may not have been genetically as close as appearance indicated. Resistance in plants is doubtless due to a complex of interesting factors. Factors that increase tannin and acid and that decrease water-soluble nitrogenous compounds tend to build up immunity.

Current Literature.

Bulletin de la Societe de Pathologie Exotique.

May 13, 1925.

Malaria at Oude (Georgia): Study on Mountain Malaria (N. Roukhadzé).—Oude is a small village in the Caucasus, 1,100 metres above sea level, with a population of 3,000 people, nearly all agriculturists or horticulturists. The cultivated lands lie in the valley of the River Koblianistchai, 1-2 km. from the village and at an altitude of less than 50-100 metres. The percentage of the inhabitants with malaria is about 27·9, mostly attacked during the month of August; there are few cases in July and only 2 per cent. in spring. 40 per cent. of the malarial patients are between the ages of ten and nineteen years. It is well known amongst the inhabitants that it is chiefly those who work in the valley of the Koblianistchai who suffer from malaria; the women and children who never descend to the valley are rarely attacked. It was only in the valley, and in no other part of the village, that mosquitoes were found. Along the canals, where the water in August is 13-14°, culex were found in quantities, but no anopheles. At 1 km. to the east of the village more anopheles (*maculipennis*) than culex were found. About the middle of August the cold commences in the mountains, and it is then that the mosquitoes leave the plains to hibernate; this has also been noted in other parts. It is believed that at Oude the mosquitoes hibernate either in the trunks of the trees or under the dead leaves on the ground. With regard to parasitology, not one case of *Plasmodium malariæ* was detected among forty-two positive cases; in most cases *P.*

præcox was present. Another interesting fact is the spontaneous cure which often occurs at Oude.

Antispirillar Vaccinotherapy in Fuso-spirochætal Affections of the Skin and Mucosæ (R. Pons).—A saprophytic germ (*Spirillum*) of the human buccal cavity gives rich cultures on solid media. Subcutaneous injection of 2 c.c. of this culture, forty-eight hours old, causes a necrosis of the epidermis and dermis in the rabbit; there is putrid gangrene of the phagedenic ulcer type on the skin, and of the "noma" type on the buccal mucous membrane. The causation of necrosis by this germ led the author to believe that it probably played some part in ulcerous affections of the mouth and, in a general way, in fuso-spirochætal affections, and therapeutic experiments were carried out on human subjects suffering from tropical ulcer. The results were excellent: in forty-eight hours all pain had ceased, the inflammation had disappeared and the ulceration had greatly ameliorated. After three days there was no sign of necrosis, and after the fourth day cicatrization commenced.

First Experiments of Antituberculosis Vaccination of Infants in Cochin China and Cambodia (J. Bablet).—Good results have been obtained with antituberculosis vaccination. Children less than ten days old were given 1 cg. (in three doses) every three days, of B.C.G. cultures prepared according to Calmette's technique. Number of children vaccinated was 506. No trouble of any sort followed the ingestion of the vaccine. Antituberculosis vaccination is now generally used in Cochin China.

Leprosy and the Wassermann Reaction (Louis Simon).—In twenty-four cases of leprosy examined by the author the Wassermann test was positive; only one case was doubtful.

The Antimalarial Campaign at Gagri in 1923 *and* 1924 (N. Roukhadzé).—During the nineteenth century Gagri was the most malaria-infected place along the southern borders of the Black Sea. At the beginning of the twentieth century the Duke of Oldenburg founded a very fine climatic station there and, thanks to public hygiene and sanitary surveillance, local malaria did not surpass 10 per cent. After the revolution, however, through lack of surveillance Gagri became unhealthy, malaria increased, and in 1922 90 per cent. of the inhabitants were attacked. In 1923 the climatic station of Gagri was restored, and the stagnant pools and reservoirs, which were full of organic residue and animals (fish, frogs, snakes, &c.) were cleared. Conditions soon began to ameliorate and the percentage of malaria infection to decrease. The parasites found in the different seasons are the same all along the southern borders of the Black Sea; in winter *Plasmodium malariæ*; *P. vivax* in spring, and *P. præcox* in autumn. From the statistics it is seen that the percentage of parasite carriers always corresponds to the intensity of the malaria epidemic in the country; and that healthy people with splenomegaly furnish a larger number of parasite carriers than do normal people with a healthy spleen. The virulence of the epidemic in 1922 is accounted for by the presence in Gagri of numerous soldiers of the Red Army and refugees who had never previously suffered from malaria. The malaria parasites in this class acquire a special virulence and cause extremely grave clinical symptoms in cases of re infection, even in chronic patients. In 1924 the malarial campaign was continued on the same lines and excellent results have been obtained, and although the population is nearly four times as large as the previous year, only two primitive cases have been reported. Already, in 1904, *Anopheles maculipennis* and *A. bifurcatus* existed at Gagri, but to-day, thanks to the anti-malarial campaign, only the latter is to be found in the local forests.

First Experiments with "309" in Experimental Cases of Trypanosomiasis and in Human Trypanosomiasis (J. Laigret and M. Blanchard).—In these experiments "309" has shown a trypanocidal action comparable to that of Bayer "205" in experimental infections of guinea-pigs (*Trypanosoma pecaudi* and *T. gambiense*). The dose of 0·05 gr. per kilo of weight completely cures the infected guinea-pigs if the treatment is carried out during the first month after the first positive examination. Later the animal can be sterilized with 0·08 gr. per kilo. In the treatment of sleeping sickness "309," like "205," proves inferior to the arsenics. Peripheral sterilization is easily obtained, but it is of short duration; it also causes albuminuria in most cases. The preventive action of this product is also good. It has not yet been possible to prove the prophylactic action of "309" in man; one must first be sure of the renal troubles that the medication provokes. It is thought there might be a possibility of cure being effected by using atoxyl-309 mixed, and that it might be advantageous in reducing the number of re-infections.

The Hæmogregarina of the Horned Viper (Hæmogregarina seurati, *Laveran and Pettit*, 1911); *its Forms of Reproduction* (H. Foley and A. Catanei).—Of 154 vipers (*Cerastes cornatus* L.) 24 per cent. harboured hæmogregarina; the affection is more frequent among the large vipers. The different forms observed are minutely described.

The Second Case of Kala-azar in an Adult of Tunisia (Et. Burnet and F. Masselot).—Before the year 1925, kala-azar had never been observed in Tunisia in people older than nine and a half years. In the *Bulletin de la Soc. méd. des Hôp. de Paris*, of April, 1925, a case was reported in a woman of 26 years of age. The present case is a woman of 39 years, born at Marseilles, where she lived till the age of 5 years; she afterwards lived in Corsica and came to Tunis in 1906, where she was a nurse in the French hospital.

On the Frequency of Asthma in Tangiers (R Remlinger).—At Tangiers, as in most places, no age is exempt from asthma, and the two sexes seem to be about equally affected, and social conditions, professions, &c., seem to have no effect on the condition. Tangierian asthma is difficult to cure and is subject to many relapses.

Original Communications.

NOTES ON THE CULTIVATION OF CERTAIN AMŒBÆ AND FLAGELLATES OF MAN, USING THE TECHNIQUE OF BOECK AND DRBOHLAV.

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AND

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Material.

The material on which the following cultural observations were based was derived from several sources. The two cases of infection with *Entamœba histolytica* were patients in the Hospital for Tropical Diseases under the care of Dr. P. Manson-Bahr, to whom acknowledgments are due for his kindness in giving access to the infected material.

The *Dientamœba fragilis* culture was obtained from a colleague on the staff, and the remainder from medical men attending the general course of the School of Hygiene and Tropical Medicine. Accordingly, while the cultures were actually obtained in London, the infections were probably obtained in widely diverse parts of the world.

The medium used for the cultivation was the Locke egg albumin of Boeck and Drbohlav with certain slight modifications.

Cultivation of *Entamœba histolytica.*

The cultivation of *E. histolytica* proved to be a comparatively simple matter, when the difficulties encountered with the other human amœbæ are considered. Some of the blood and mucus from the stool was placed in culture tubes, incubated at 37° C. for twenty-four hours, and then examined. The amœbæ were very scarce, indeed, so scanty were they that it was only after prolonged search that one individual was found, nor did they increase in numbers at the subsequent examinations. Subcultures, however, were made and these proved to contain a considerably greater number of individuals. Thereafter it was simply a matter of daily transplanting some of the fluid from the base of the tube and from the surface of the lowest part of the egg slope to ensure a continuance of the strain. The amœbæ continued to increase in numbers until the experiments were terminated.

The first strain was isolated on March 25, and was discontinued on July 25, 1925, the cultures having been transplanted ninety-six times, in all 121 days. The initial culture of the second strain was made on June 14, and discontinued on July 25 also, the number of transplants being thirty-seven over a period of forty-two days. From the experience obtained with the other protozoa cultivated in this manner there seems no doubt but that the simplicity with which both these strains were maintained, was due to the fact that *Blastocystis hominis* was not present in the cultures.

Attempts were made to experimentally infect a kitten by rectal injections of the cultures, but with negative results. It is intended to repeat these inoculation experiments at some future date.

Owing to the fluid nature of the medium fixed and stained preparations were not particularly easy to obtain. Those, however, which were well stained showed amœbæ morphologically identical with those in the stools of the patients, except in one particular, viz., the cultural forms ingested bacteria. Boeck and Drbohlav succeeded in getting the *Entamœbæ* in their cultures to feed on red blood-cells when a quantity of blood was added to the medium. On the occasion when human blood was added to the cultures of the two strains under discussion no amœbæ were found with included red corpuscles.

Various other media were tried, but it was found that the strains, once established on the Locke egg albumin, did not progress so favourably on the others. Slopes of blood-agar were used, also agar, nutrient-agar and egg-agar slopes.

Encystment took place from time to time in the cultures. The cysts were always scanty, and their numbers did not appear to bear any relationship to the numbers of free amœbæ. No reason was apparent why cysts should appear in one tube and not in another. Age of the culture had seemingly no bearing on the question, since, owing to the bacterial overgrowth in the older tubes, growth, multiplication and encystment were inhibited. The cysts were found in tubes which were about forty-eight hours old. They had one, two and four nuclei, and had the characteristic rod-shaped chromatoid bodies.

Movement of *Entamœba histolytica.*

The different ways in which the various species of amœbæ moved was most striking, each having its characteristic mode of progression. For the purpose of observing the movements a warm chamber was used which enclosed the whole microscope.

When actively motile, *E. histolytica* became stretched out in a ribbon-shape with blunt rounded ends. The ectoplasm, while clearly differentiated from the endoplasm, yet tended to maintain the general outline of the amœba. That is to say the blunt, round, anterior end consisting of the ectoplasm was the same width as the remainder of the body. Movement was usually more or less direct, not as in some of the other species, indeterminate, and the distance covered considerable. The nuclear structure was always of the same type as that found in man, but the body showed greater vacuolation and also contained ingested bacteria.

Entamœba coli.

A strain of *E. coli* was maintained for sixty-nine days. Transplants were made daily. This culture, as were all the others, with the exception of the *E. histolytica*, was badly contaminated by *Blastocystis hominis*, which grew and multiplied at such a speed as to completely occlude all the protozoa present.

By making such subcultures practically every twenty-four hours, it was found that the amœbæ could keep pace with the growth of the *Blastocystis*. No cysts were found in the cultures.

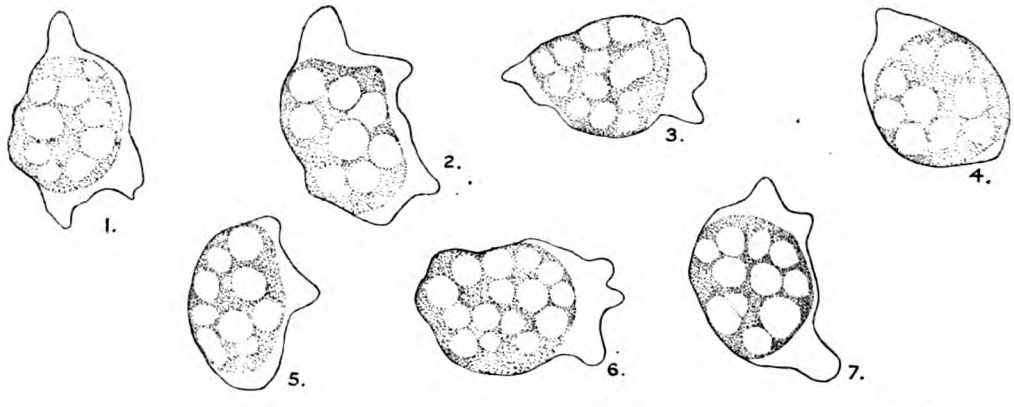
MOVEMENT AND MORPHOLOGY OF *E. coli* IN CULTURE.

Morphologically, the specimens in culture did not differ from those found in fresh human fæces. They appeared to be very susceptible to changes in temperature, and, if placed on a slide which was more than three or four degrees below 37° C., they rounded up, and withdrew their pseudopodia. When actively motile, they showed a clearly marked differentiation between the clear hyaline ectoplasm and the coarsely granular endoplasm. In view of the old conception of *E. histolytica* having a much more clearly defined ectoplasm than *E. coli* the large amount of ectoplasm shown by the majority of the cultured *E. coli* was striking. They did not tend to progress over the slide, but moved about over the same spot, extruding their large, blunt, rounded pseudopodia in all directions. The movement was, in comparison with that of the other species, sluggish and ponderous. The body was usually rounded, and seldom adopted the wide ribbon or band outline of the *E. histolytica*, and, if it did, soon returned to the rounder or more compact shape.

Dientamœba fragilis: ITS CULTIVATION, MORPHOLOGY AND MOVEMENT.

A stool was obtained from a person who was known to be a carrier of this amœba and a portion was placed in a warmed culture tube very soon after the passing of the fæces. The following day there was a huge growth of the *Blastocystis*—in parentheses it may be said that it has never yet been found possible to find *Dientamœba fragilis* in a stool which did not have a heavy infection of these vegetable cells—but no amœbæ were discoverable. Subcultures, however, were made, and these also were without result, but on culturing for a third time, a few amœbæ were identified. They were approximately the same size as the blastocysts, and, using a low magnification, could quite easily be missed. Subsequently, the dientamœbæ grew fairly well, although it was extremely difficult to keep pace with the overgrowth of the blastocysts. The cultures, too, seemed to show a certain degree of periodicity as regards the numbers present. Making daily subcultures of approximately the same quantity of fluid each time it was found that the numbers of amœbæ increased daily for about five or six days, when they attained their maximum. They then dropped off suddenly, so that for two or three days it might be a matter of difficulty to demonstrate a single individual, and, next, gradually picked up again.

Previous observations on *D. fragilis* have shown that the ratio of binucleate to uninucleate individuals was about four to one. In culture the ratio was increased to five, sometimes six, or even more, to one. They tended to be uniform in size, and did not often show the same extremes as are found in human stools. The nuclear structure is the same as that previously described (Thomson and Robertson, 1923).



A. R. del.

FIG. 1.—Camera lucida drawings at a magnification of approx. × 1,600, of the successive shapes adopted by a single moving *Dientamœba fragilis* at intervals of from fifteen seconds to one minute.

The movement is characteristic. Text fig. 1 shows graphically the successive shapes adopted by one amœba. They were drawn with the camera lucida, the microscope being in a warm chamber at 37° C., and are as accurate representations as can be obtained by such means of continually moving organism. Dientamœbæ do not tend to cover a great deal of ground, staying, rather, in the same situation, extruding pseudopodia in an aimless fashion in all directions.

The pseudopodia are pushed out rather suddenly, but not to any great distance. In outline they are conical, and, as soon as the pseudopod has reached the extent of its travel, it usually widens, so that a flattened band of ectoplasm surrounds a considerable part of the circumference of the body. From

this wide, flattened, leaf-like (as Dobell, 1918, originally described it) pseudopodium, other conical processes may come out, still further accentuating the crenated leaf-like appearance.

No cysts were ever found in the cultures. The blastocyst infection, mentioned above, was so intense that the amœbæ were overgrown in a very short space of time, too soon, probably, to permit of cyst formation even supposing the other conditions were suitable. The method suggested by Boeck for ridding flagellate cultures of blastocysts by centrifuging the culture, allowing the tubes to stand for some minutes and then pipetting off the fluid containing a few flagellates, but supernatant to the blastocysts, was unfortunately of no avail in the present instance.

The characteristic degeneration of *D. fragilis* was well seen in these cultural forms. In one respect, however, they differed from the preconceived ideas of the amœba, viz.: they were much more resistant to external influences than the forms in the fæces. It is perfectly true that they are peculiarly susceptible to the influences of temperature variations, a fall of even a few degrees being sufficient to cause them to round up and withdraw the ectoplasmic projections, but if the temperature is raised again to 37° C. they will move as actively as before. Specimens have been kept under observation, with the microscope in a warm chamber, for three hours or even longer without any apparent change. Light certainly has an effect upon them resulting in a slowing of the movement, yet they will tolerate even a fairly strong illumination for at least half an hour, and still be actively motile. It seems a possible hypothesis, therefore, that the rapid death and degeneration of the amœbæ soon after leaving the body is due not so much to the adverse conditions of temperature, &c., as to the fæces constituting an unfavourable medium. If this should happen to be the case it might be the explanation why cyst formation does not, so far as is known, take place in the human body. Kofoid, 1923, reported the finding of the encysted stage in the fæces, and gave illustrations of uninucleate and binucleate cysts. Forms, similar to those he figured, have frequently been found in the cultures, and in cases of human infection, but it has not been possible to produce convincing evidence of their cystic nature. It seems much more likely that these are rounded up amœbæ with a thin layer of protective ectoplasm all round.

The Probable Cultivation of *Iodamœba bütschlii*.

Portions of fæces each having a heavy infection of *Iodamœba bütschlii* cysts were planted in culture tubes. On each occasion there was a rapid growth of amœbæ. Unsuccessful attempts were made to infect a kitten by rectal injections of the cultural amœba. It is accordingly impossible of proof that *Iodamœba* was cultivated on this occasion, although extremely probable. There were in fæces from both patients a few free, or, better, precystic iodamœbæ. A further reason why greater insistence is not laid on this claim to have cultivated *Iodamœba bütschlii* is the similarity between certain free-living forms and the amœba in question, and, while every possible precaution was taken to avoid contamination this could not be absolutely excluded. On the other hand, it is most suggestive that the same response was obtained on the two occasions, when cultures were made of iodamœba cyst cases, and on these occasions only. Lastly, the amœbæ in culture corresponded closely with the descriptions of free *Iodamœba bütschlii* in the literature.

Movement and Morphology.

The movement is very similar to that described in the case of *Entamœba histolytica*. A series of outline drawings, which were drawn in the same manner and at the same magnification as those of *Dientamœba fragilis*, of an amœba has been made to illustrate the method of progression. The amœba is usually stretched out in an elongated form, and is rather wider towards its posterior end, i.e., the end opposite the direction of travel. The pseudopodia are blunt, about the same width as, or a trifle less than the width of the body, and are composed of clear hyaline ectoplasm. The direction of movement is chiefly straight, and, if the amœba meets with an obstruction, it attempts to shove its way through rather than withdraw and change its line as *Dientamœba* would do. The body is vacuolated and may contain bacteria, &c. The nuclear structure does not differ in any way from that already described by many workers.

Cysts were never formed. In addition to the ubiquitous *Blastocystis* both cases also had *Trichomonas hominis*, and, indeed, this may serve as a good example of what may be termed a hidden or "occult" infection. Despite a careful search of the stools, by several individuals working independently, no trichomonas was found, and it was only after the cultures had been running some days that the presence of the flagellate was discovered. These flagellates gradually grew more numerous, but as they did so the numbers of the amœbæ declined until eventually a pure culture, pure in the protozoological sense, was obtained. At first the rapid growth of the amœbæ, the gradual increase of the flagellate, as if fighting an uphill battle, the eventual ascendency of the trichomonas and the final extinction of the amœbæ was most striking. The iodamœba culture ran for forty-six days over a series of forty subcultures before the amœbæ had finally disappeared. The second culture was discontinued after a shorter period.

Cultivation of *Endolimax nana*.

A strain of *E. nana* was obtained from one of the members of the General Class of Tropical Medicine, who had recently returned from abroad. The amœbæ, once they had become accustomed to the medium, grew fairly well, but the cultures always required careful watching. No cysts were formed. The culture was discontinued after nineteen days and the number of cultures was fifteen.

Morphology and Movement of *E. nana*.

The nuclear structure and cytoplasm did not differ in any essential from the fæcal forms. Just as the movement of the cultural *Iodamœba* closely paralleled that of *E. histolytica*, so does that of *E. nana* bear a resemblance to that of *E. coli*. The amœba tends to remain compact, while the wide pseudopodia are extruded in aimless fashion in all conceivable directions. It changes its situation but slowly, preferring to remain in one spot.

Cultivation of Certain Flagellates.

As noted above, no difficulty was experienced in getting *Trichomonas hominis* to thrive in this medium; it was not such an easy matter to get certain other intestinal flagellates to grow in it. *Chilomastix mesnili* was found to grow extremely well, when the expedient which will be described later in connection with *Tricercomonas intestinalis*, was adopted.

Tricercomonas intestinalis Wenyon and O'Connor, 1917.

The person in whose fæces *Tricercomonas intestinalis* Wenyon and O'Connor was found had been in England for about two months previous to the date on which his stools were examined. He was British by birth, but had been resident for some considerable time in the Federated Malay States. There was no history of his having suffered from intestinal disorder at any time, nor had his fæces ever been examined before for protozoa. The flagellates were present in considerable numbers in the fluid parts of the stool, and cysts, too, could also be found with a certain amount of difficulty, partly because of their small size and their scarcity, but more especially the ease with which they could be confused with the smaller *Blastocystis*, which were very abundant.

A quantity of the fæces was placed in a tube of Locke egg albumin, and incubated for twenty-four hours at 37° C., when it was found that the flagellates had increased in numbers, and many forms were in process of division. Subcultures, accordingly, were made, but these proved unsuccessful, no moving forms being found in twenty-four hours. The original culture, on the other hand, still contained numerous actively motile flagellates after eight hours had elapsed, so that the conclusion was arrived at that the medium was probably deficient in something which had been present in the first instance. Portions of human fæces each about the size of a pea, which had been sterilized by boiling, were added to fresh culture tubes, and these in turn were inoculated from the original culture. No difficulty was experienced after that in continuing the strain, but the flagellates did not thrive if the small portion of fæces was not added to each tube.

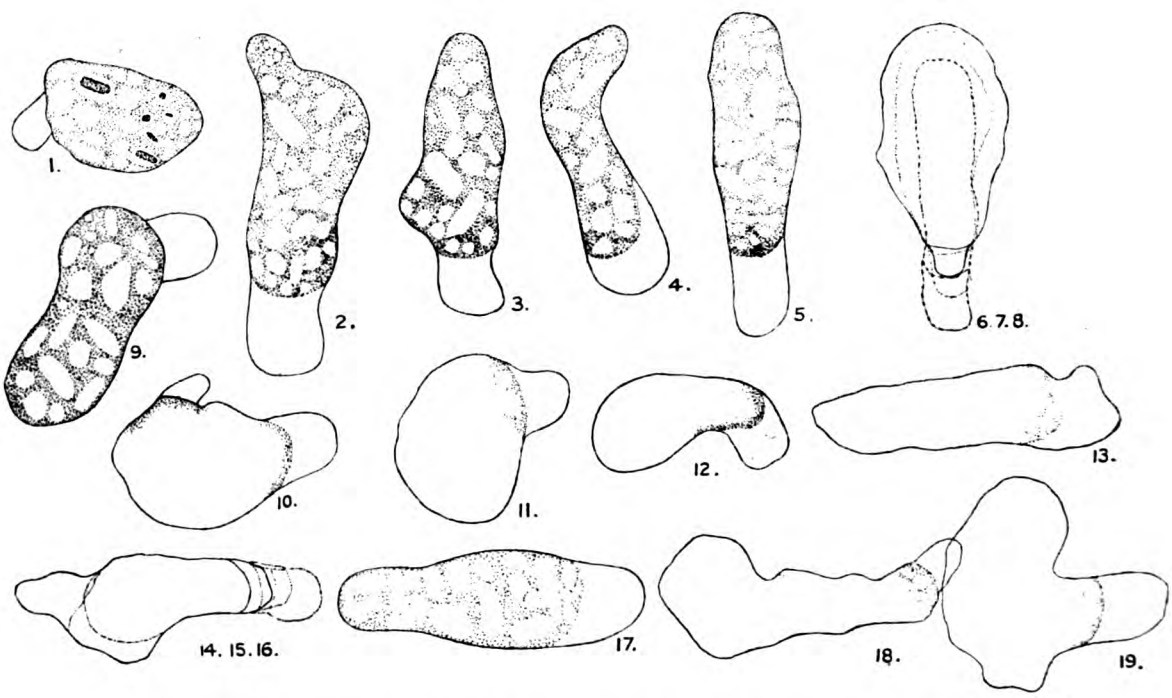


Fig. 2.—Camera lucida drawings at a magnification of approx. × 1,600, of the successive shapes adopted by a single moving amœba from a culture of human fæces containing *Iodamœba bütschlii*.

Morphology and Movement of *T. intestinalis*.

The morphological characters of this flagellate of the human intestine have been accurately described by previous workers. Dobell and O'Connor

(1921) raised the question of the identity of *Tricercomonas intestinalis* Wenyon and O'Connor, 1917, with *Enteromonas hominis* da Fonseca, 1915. It is quite clear from the study of the flagellates in the fæces and in culture that *T. intestinalis* differs from the description given by da Fonseca.

The free forms of this parasite show an extraordinary degree of motility. At first the movement of the flagella, and of the organism as a whole, is much too rapid to allow of accurate observation, but after an interval of about one and a half to two hours the quickness of the lashings is much modified. Dark ground illumination is very helpful in determining the nature of the movements. There are three anterior flagella arising close together from what appears to be a single blepharoplast. These do not work in unison, nor do they propel the organism in the same direction, but rather produce an erratic series of jerky movements towards whichever side the most recent flagellar propulsion has taken place. The fourth flagellum, which has a separate blepharoplast, leaves the body at some distance from the three anterior flagella, the intervening portion of the body being flattened and less liable to the amœboid movements shown by the remainder of the body. This flagellum is stouter and a trifle longer than the three anterior flagella, and its function seems to be more to steady and direct the body rather than to directly propel the organism. When the movement is studied in organisms which are fresh, the combined result of all the flagella lashings is, in addition to propulsion forwards, a peculiar vibratory motion which can best be described as "hovering."

Encystation has occurred in the cultures. The cysts were never numerous, nor did they in any way correspond with the number of free forms in the cultures. The peculiar granules, brown staining with iodine, which have been noted in a previous paper (Thomson and Robertson, 1925) as occurring in the cysts in fæces were present in the cultured cysts.

Giardia (Lamblia) intestinalis.

All attempts up to the present to cultivate *Giardia* have been negative.

Summary.

(1) The work of Boeck and Drbohlav on the cultivation of *Entamœba histolytica* and *Entamœba coli* has been confirmed.

(2) *Dientamœba fragilis* has been cultivated.

(3) *Endolimax nana* and *Iodamœba bütschlii* have also been cultivated, but experiments to inoculate kittens with the cultures were negative.

(4) *Trichomonas hominis*, *Chilomastix mesnili* and *Tricercomonas intestinalis* grow readily on the medium of Boeck and Drbohlav to which has been added a small quantity of fresh sterile human fæces.

(5) The movements and behaviour of the organisms in culture have been studied.

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SOME OBSERVATIONS ON THE COMMON ENDEMIC FEVERS OF CEYLON.

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The Malarial Fevers.

Malarial fever is by far the most prevalent fever in the island, so much so indeed that in very febrile illness it is a wise precaution to examine the blood for the presence of the plasmodium. The parts of the island in which the disease is most prevalent are the northern, the north-western, the north-central and the eastern provinces. In fact, the whole island with the exception of the south-western districts may be said to be malarious. If the incidence of the disease may be accurately gauged by the enlargement of the spleen noted in school children, according to Carter, now making researches for the Government in the country, there is a percentage of 60 to 70 in the northern half, and of 40 to 50 in the south-east. The hilly districts given over to the tea plantations are mostly immune. Practically every hospital in the island, however, is continually admitting patients suffering from the fever, owing to the fact that those afflicted rarely take sufficient treatment to eradicate the disease and are prone to frequent relapses. I am afraid medical officers do not sufficiently realize the importance of the prolonged treatment required to bring about a cure in malarial fever, while the ignorance and apathy of the public, and particularly the native villagers, are greatly to be deplored and are a great hindrance to all measures directed to the abolition of this scourge. In the Colombo General Hospital, for example, it is no exaggeration to say that at least a dozen cases of malarial fever are on an average admitted to the wards daily throughout the year, of which only an occasional one can be traced to having been infected in the city.

Breeding Grounds and Varieties of the Anopheles.—The island has not yet been thoroughly examined for a definite statement on this point, but Carter, of the Liverpool School of Tropical Medicine, who is at present engaged in researches for this pur-

pose, is hoping shortly to be able to publish the result of his findings. It is well known, however, that in the City of Colombo the anopheles has been found in more than one breeding ground.

Varieties of Fever.—Quite 80 per cent. of the cases of malarial fever in the island, certainly at the Colombo General Hospital, are of the benign tertian type, the other 20 per cent. consisting of about 18 per cent. subtertian and 2 per cent. quartan. A large percentage of these patients is really suffering from a relapse, as the notes of my cases prove, and must, therefore, most definitely demonstrate the haphazard way in which those afflicted carry out the necessary treatment, while on the other hand this observation augurs well for success in combating the disease if only some scheme could be devised for compulsory treatment for as long a period as a couple of months.

Mixed infection is not uncommon and generally consists in the grafting of a subtertian on a tertian infection, producing a continuous type of temperature that may be most baffling unless a careful examination of the blood has revealed the cause.

The subtertian infection, as is well known, may produce a very atypical fever differing in its manifestations according to the internal organ in which the parasite mainly sporulates, a feature to which Castellani has particularly drawn attention in an admirable and exhaustive description of the varieties in his "Manual of Tropical Medicine." In the island, as far as my personal observation goes, it is the cerebrospinal nervous system that is chiefly affected with symptoms of coma or of cerebrospinal meningitis, which is very fatal. Next in frequency is the gastro-intestinal type. Genuine blackwater fever is unknown, although the subtertian parasite is so frequently found as an infecting agent, notwithstanding the observations of Stephens. The only case I have heard of for the last eighteen years was undoubtedly one of malarial hæmoglobinuria.

Complications and Sequelæ.—Although many intercurrent diseases may be found during an attack of malaria, the complications are of no importance, but of sequelæ, those affecting the nervous system are not infrequent, while cirrhosis of the liver is fairly common and I have, moreover, met with three cases where diabetes has followed repeated attacks of malaria. The coincidence is certainly remarkable and worthy of close consideration since diabetes is so common in the island. In this connection it is worthy of note that Castellani and Whitmore have reported on two cases of glycosuria in malarial subjects where the urine was rendered sugar-free by the administration of quinine.

Chronic malaria is far too frequently met with in the island, and a percentage of ten among the hospital admissions for malaria is by no means too high. Resulting as it does from insufficient treatment of the acute disease, the importance of quinine treatment for a prolonged period should be more generally appreciated.

As far as my own observations go, the amount of chronic ill health due to chronic malaria is appalling. It is not only the enormous enlargement of the spleen, the enlargement of the liver and the profound anæmia that are so deplorable, but I have found chronic heart disease from myocardial degeneration and chronic Bright's disease far too frequently follow, to be a mere coincidence, when all other possible causes have been eliminated.

As regards treatment of the condition, I have found prolonged quinine administration with repeated courses of novarsenobillon intravenously to be the most satisfactory, although some benefit has also followed the use of a 1 : 1,000 solution of mercury perchloride intravenously, as I described in the Administrative Reports by the Commissioner for Medical Services for the year 1924.

Finally, as a preliminary to preventive measures on an extensive scale, the species of the anopheles acting as carriers are being carefully picked out, while it has been found that the *Gambusia affin* or "millions," the West Indian species, is prolific in breeding and vigorously attacks the larvæ wherever experiments have been made.

Intestinal Fevers.

Typhoid.—Of the various intestinal fevers typhoid is by far the commonest and prevails throughout the year, although its seasonal incidence is greater in the later months. The disease claims so many that in the City of Colombo a special hospital has been built and is maintained by the Municipality for receiving and treating only those so afflicted, and even so all the other general hospitals, too, are continually admitting quite a number of them.

There is no doubt in my own mind that the ætiology of enteric fever in Ceylon is bound up with the common house-fly, for not only does the seasonal incidence coincide with the height of the breeding season of the *Musca domestica,* but it is a fact that since the sewage of Colombo has been changed into a water-borne one there has been a marked decrease in its incidence. Only 709 cases were reported in the year 1923.

The type of fever is mostly of the mild or moderately severe form, running a benign course and terminating in three weeks with only occasional slight delirium and some gastritis and generally marked by constipation. This has been the particular feature of change that I have noticed for the past fifteen years. This statement does not imply, however, that a severe type with more serious complications running a longer course with relapses is not common, for every now and again these cases are being met with, and the medical man will be wise who is ever on the alert to notice early the changes which betoken the likely complications, for the disease still claims a high toll. Writing as I am, far away from statistics, it is not possible for me to give figures, but I should venture to say it was about 10 per cent.

Of the severer complications parotitis is certainly the most frequent, but I am not willing to subscribe to the opinion of writers of textbooks on medicine

that it is a very fatal one, for the majority of my cases have recovered. Hæmorrhage is next in order of frequency, about 15 per cent., and furnishes most of the deaths, marked toxæmia with severe nervous symptoms and heart failure being also of great import in a number of cases, as well as perforation.

On the whole one may say, however, that the disease is milder than it was two decades ago, and it would seem as if there has been forming a considerable degree of immunity in the indigenous native population. It is otherwise with Europeans, particularly if of recent arrival in the tropics, for in them the disease is usually more severe and is more liable to usher in grave complications.

Paratyphoid A Fever is not infrequent in the island where it was first reported by Castellani. About 3 per cent. of intestinal fevers only, however, belong to this group. The most frequent carrier is again undoubtedly the house-fly, but the bacillus can also live in the gall-bladder for a good length of time and be passed out in the fæces and so be a source of infection to others.

The disease runs a mild course in some cases, although I have known of one death at least in the island in private practice that was attributed to this germ.

Paratyphoid B Fever.—Although this fever is the common type met with in Europe, it is very infrequent in Ceylon. Not a single case in a series of 500 was due to it.

Paratyphoid C Fever of Hirshfield.—No case of this type, so recently described as occurring occasionally in Europe, has ever been observed in the island, although it is possible that some of the unclassified fevers in the island may turn out to belong to this group on investigation.

Parenteric Fevers.

These, as is now known by medical men practising in tropical and subtropical countries, are a group of fevers which clinically resemble the enteric group, but yield negative agglutination tests for typhoid, paratyphoid A, B and C. Castellani first showed, in 1905, that they are due to intermediate intestinal germs and, since then, their nature has been recognized by a large number of observers in India, the Philippine Islands, the Sudan, Egypt, parts of Europe and even in Great Britain. These fevers account for a large number of the so-called "Unclassified Fevers of the Tropics," and in Ceylon, at any rate, some of them are due to the *Bacillus columbensis* (Castellani, 1905) and the *B. asiaticus* (Castellani, 1904). The proportion of cases in the island I am unable to state, as unfortunately no attempt has been made to investigate their nature with any method, but that they occur frequently is undoubted from the number of cases of enteric-like fevers returned "negative" to the "enteric" group by the bacteriologist. It is suggestive that the number of deaths reported in 1923 from diseases classed as "pyrexia" was 5,024. Khaled has recently put down the incidence in Egypt of the most frequent "parenteric" fever to that of 10 per cent., which he states is of the "asiaticus" group, but in Ceylon half that percentage for the whole class would be more nearly correct.

The clinical course of these fevers is very like that of the "enteric" group, with a fever of a frequently irregular type and lasting for from three to nine weeks, but complications are rare and intestinal symptoms often lacking. The prognosis is on the whole very favourable.

Relapsing Fevers.

The island is happily free from the relapsing fevers commonly met with in Europe, Africa and America, whether the infecting vector is a louse or a tick. The only true relapsing fever that is frequently encountered is rat-bite fever, an account of which I have previously contributed to this Journal in 1923.

The specific spirochæte, however, causing the disease in Ceylon has not yet been found, and it must be left to future researches to decide whether it is the same as the *Spirochæta morsus murium* of the Japanese observers, in view of Rowe's findings in India. No instances of the relapsing fever of India due to the *Spiroschaudinnia carteri* have ever occurred.

The Kala-azars.

True kala-azar is not endemic in the island, but imported cases are seen, though very rarely. It was on a patient who had contracted the disease in India that Castellani first tried tartar emetic, with good results, in 1914.

What are known as the pseudo-kala-azars are, however, by no means infrequent, inasmuch as they resemble the true disease in the association of anæmia, emaciation and splenomegaly, although no specific parasites have ever been found. That the syndrome constitutes a clinical entity is very probable from the fact that cases have been reported from the Philippine Islands, India, Egypt, Northern Africa and South America. In one case of this type, Castellani found protozoal bodies in the spleen after death, which he named *Toxoplasma pyrogenes*.

Dengue and Allied Fevers.

Dengue first appeared in the island about the year 1905, coming from China via Burma and Singapore. The disease is very prevalent in the low-lying sea coast towns during the prevalence of the south-west monsoon, that is from May to September, and has not been known to prevail inland.

We now know from the experiments organized by the Medical Department Research Board of the United States Army, and conducted by Siber, Hall and Hitchens, as published in the *Journal of the American Medical Association*, April 18, 1925, that the *Stegomyia fasciata* is the only carrier, fully confirming the results obtained by Deland, Bradley and McDonald. A patient suffering from the disease is infective to the mosquito for the first three days, the virus takes eleven days to become mature in the body of the mosquito before its bite can infect a non-

immune human being, and the mosquito is thought to remain infective during the remainder of its life.

As to the type of the disease in Ceylon, it runs its usual course, producing a saddle-back type of temperature, severe head, arthritic pains and slight bronchitis being very common. On the whole I think, however, that the attacks are not as severe in recent years and that the disease is tending to be milder. The joint pains especially seem to be much less severe than formerly.

Seven-day Fever.—Seven-day fever, described by Sir Leonard Rogers, in India, is now known to be the same as dengue fever and needs no further mention.

Yellow Fever is unknown in the island. Seeing that this disease is only transmitted by the bite of the *Stegomyia fasciata*, there is a constant apprehension that the disease may one day be introduced into the island and cause a widespread epidemic with a heavy toll of life, for the stegomyia is a very common mosquito in the sea-coast towns.

The mechanism of transmission in the two fevers being so alike, it has been further suggested that the infecting organism of dengue fever may fall into the same group as that of yellow fever and be a filterable virus present in the peripheral blood, and capable of causing the disease by infection with the blood, while clinical resemblances have been claimed before mild attacks of yellow fever and typical cases of dengue.

Filarial Fever.

This is a very frequent type of fever in the island where elephantiasis is so common. Its importance lies in the fact that it is often thought to be malarial in nature, particularly at an early stage of the disease and before any elephantoid changes have occurred. Especially is this the case when there is no pain complained of in the affected lymphatic area, and only a careful examination will reveal the inflamed vessel. The attack often commences with a rigor and a high temperature. In other cases, especially by the uninitiated, the true nature of the fever is not understood and patients will insist that they are suffering from erysipelas, but the affection is not of a streptococcal origin. The correct diagnosis rests on the history of the case and the possible finding of a hardened lymphatic as a cord when the attack has subsided.

Plague

has undoubtedly come to stay in the island, or rather Colombo, for since the first case was discovered by Castellani, in 1914, when Director of the Bacteriological Institute, other cases have ever been recurring. The endemic area is only Colombo, and whenever a stray case has occurred outside the capital, infection has always been traced to that source. The truth of this may be seen from the Report of the Principal Civil Medical Officer for the year 1921. In that he states: "The total number of cases reported was 187, with 171 deaths. Of these 187 cases, 184 occurred in Colombo, of which 145 occurred in the first quarter of the year."

From this report we further learn why the island is so comparatively immune from the disease in an epidemic form, when the neighbouring continent of India has been devastated by it. In the early part of the year the maximum temperature, especially at night and in the mornings, is many degrees lower than in the so-called hot weather, and even in Colombo this may be and often is in the seventies, and we know that while the bacilli in the flea are virulent at a temperature of 70°, they rapidly disappear from its stomach at temperatures above 85° and are then ineffectual. There is also another reason. Hirst has pointed out that the commonest rat-flea in Ceylon is the *Xenopsylla astia*, Rothschild, and this flea is said to bite man with great reluctance at temperatures above 80°.

As regards the type of the disease in the island, the bubonic form is by far the commonest, quite 70 per cent. of the cases falling into that category. Next in frequency is the primary septicæmic type, 9 per cent., and 1 per cent. pneumonic. By this is meant primary pneumonic plague with frothy, slightly blood-stained sputum or liquid hæmorrhagic sputum and often no characteristic pulmonary physical signs, and has to be distinguished from pneumonia secondary to bubonic plague with definite sticky and rusty sputum. The two types last mentioned are, of course, always fatal, as elsewhere.

Fevers due to Helminth Infections.

Only these two types are at all important. The most frequent is that associated with infection by the hookworm. A type of fever is produced that is either intermittent or irregularly remittent. In the latter case it is often thought to be enteric, but the differential diagnosis presents no difficulties. The intermittent type being the commoner must be carefully distinguished from malaria, especially in view of the fact that the *Ankylostomum duodenale* is such a common intestinal parasite. Anæmia and enlargement of the spleen are also found in both infections.

The fever in ankylostomiasis, it is worth remembering, is believed by Castellani to be of bacterial origin and due to the entry into the blood-stream of intestinal bacteria through the small wounds in the intestinal mucosa produced by the worm. That this is a likely theory may be seen from the fact that the fever often continues, even after the parasitic infection has been got rid of.

In infection by the *Ascaris lumbricoides*, too, there is sometimes produced a fever which resembles typhoid, which however consistently gives negative results to agglutination of that germ.

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THE TREATMENT OF ORIENTAL SORE.

ORIENTAL sore has a patchy geographical distribution and has caused various local names to be applied to the condition. A few may be quoted: Delhi boil, Aleppo boil, Biskra boil, Baghdad boil, Ulcera de Bauru (Brazil), Bouton d'Orient, Chancre du Sahara, Dermatite Ulcéreuse Circonscrite (Corre), Mycosis Cutis Chronica, Lupus Endemicus, Cutaneous Leishmaniasis.

Three species of leishmania are known to occur in man morphologically similar but pathologically different, namely, *Leishmania donovani,* Laveran and Mesnil 1903, causing kala-azar; *L. infantum,* Nicolle 1908, causing infantile splenomegaly; and *L. tropica,* Wright 1903, with its variety *L. americana,* causing cutaneous leishmaniasis.

The infectivity of this organism has been definitely proved by direct inoculation both in man and animals. Neither race, age, sex, occupation nor social condition materially affects susceptibility to infection. Insect carriers have long been subject to suspicion, but, up to the present, no insect has been definitely demonstrated to be the true host of *L. tropica.*

After an inoculation period variously stated in days, weeks or months, ulceration of the skin commences and slowly extends so that it may eventually occupy an area several inches across, though usually it presents a diameter of about one inch. After a period varying from two to twelve months, or even longer, healing commences by granulation, but the process is often slow and interrupted. Healing is eventually complete, but much scarring may result. It would appear that a tropical sore produces a definite immunity, so that, as a rule, second attacks do not occur.

Many and various are the forms of treatment which have been advocated for this condition. Excision of the sore has been advised. Various antiseptics have been employed, either as lotions, powders or ointments. These include perchloride of mercury, carbolic acid, permanganate of potassium, tincture of iodine, boric acid, silver nitrate, protargol and methylene blue. Salvarsan and atoxyl have been used without any good result. X-rays, light treatment and carbondioxide snow have all been more or less favourably reported on. More recently good results have been recorded from the injection into the base of the sore of gradually increasing doses of emetine hydrochloride.

The most successful results, however, have been achieved by the use of tartar emetic, which has been described as a specific for this condition, and of phosphorated oil. The former is best administered in the form of intravenous injections, using a 1 per cent. solution in saline solution or in distilled water. It may also be given by intramuscular injection, but this method suffers from the drawback that solutions of tartar emetic, as of other antimonial salts, are painful and apt to induce the formation of abscesses. Lastly, tartar emetic may be locally applied as a 1 per cent. ointment or as a 1 per cent. lotion, but the local application of tartar emetic in powder, which has been recommended, should be avoided on account of its extreme painfulness.

Phosphorated oil in the form of the oleum phosphoratum of the British Pharmacopeia was first advocated by Castellani in 1923. He had found that the use of this preparation by subcutaneous injection was practically painless, and, provided small

doses were employed, there was no risk of phosphorus poisoning, either immediate or delayed. Good results have been recorded from its use in several cases. It is essential that the phosphorated oil should be of recent preparation. It is now placed on the market in very convenient ampoules by Martindale. Its mode of employment is as follows: When the ulceration is well marked the oil is simply applied directly to fungus and margins of the ulcer, after removing the scab, and this simple treatment alone was found to answer admirably in several cases. When the lesion is a nodular one and there is little ulceration, in addition to the direct application of the oil, subcutaneous injections should be given. In carrying these out a sterile 20 minim all-glass hypodermic syringe is used, three to five minims of the recently prepared phosphorated oil are drawn in and then injected around the lesion by inserting the needle of the syringe under the skin round its margin; two or three drops of oil are then dabbed on the surface of the ulcer. This procedure is repeated once or twice a week, according to the amount of local reaction which ensues. If this is severe, as only very occasionally happens, the injections should be discontinued for a time and hot boric fomentations applied.

Subcutaneous injections of phosphorated oil have also been employed at Castellani's suggestion in other conditions, such as rickets and osteomalacea, and, as an adjuvant to quinine and arsenic, in certain cases of chronic malaria cachexia. It has further been suggested that this method of treatment might also be tried and found of benefit in other forms of leishmaniasis, as well as in certain cases of ulcer of non-leishmania origin, as, for example, granuloma inguinale, ulcus tropicum and certain persistent tropical ulcerations of obscure origin.

F. E. T.

Annotations.

Treatment of Hookworm Disease with a Mixture of Carbon Tetrachloride and Ascaridol (W. G. Smillie, *American Journal of Tropical Medicine*, January, 1925).—Carbon tetrachloride in diminished doses, when used in the treatment of hookworm disease, has a selective action upon female hookworms and does not remove ascarides. Ascaridol, the active principle of chenopodium, in diminished doses has a selective action upon male hookworms and is remarkably efficient in removing ascarides. A mixture of the two drugs does not increase their toxicity toward the host, since carbon tetrachloride has a specific action upon the liver, whereas ascaridol affects chiefly the central nervous system. An anthelmintic approaching the ideal for field treatment of hookworm disease is obtained by administering 2 c.c. of a mixture containing 4 parts carbon tetrachloride and 1 part ascaridol. The mixture is highly efficient, comparatively non-toxic, easy to administer and inexpensive.

Mercurochrome in the Treatment of Chronic Malaria (D. B. Avison and Byrom Koo, *The China Medical Journal*, May, 1925).—The treatment of chronic malaria by a single intravenous injection of mercurochrome (0·003 grm. per kilo of body weight in a 1 per cent. solution) has given a cure of 100 per cent. of cases treated by the authors. Patients admitted to the hospital in the morning with the diagnosis of chronic malaria and given a sufficient dose of mercurochrome have been discharged the same day apparently cured. Where the conditions permit, the treatment may be safely given in the patient's home. The average native patient should be admitted to hospital until the chill or vomiting reactions are over.

The Concentration of Quinine in the Circulating Blood (H. W. Acton and R. N. Chopra, *Indian Journal of Medical Research*, July, 1925).—The results of these investigations are as follows: The administration of alkalies before quinine enhances the rate of diffusion through the mucous membrane of the small intestine, so that the concentration of quinine is almost doubled in the mesenteric blood. The rate of diffusion of quinine is lessened when the substrate is acid, as in the stomach, or when the mucous membrane is congested or diseased (e.g., gastritis), so that the concentration of quinine is considerably reduced from the normal. The concentration of quinine is greater in the mesenteric blood than in the systemic blood, probably owing to the absorptive action of the liver. The increase in the cure rate of quinine following the alkalies is dependent on the greater concentration of quinine in the blood, and not to the slight alterations in the pH of the blood. The difference in the cure rate of the three different malarial fevers is dependent on the concentration of quinine coinciding with the site of sporulation. Thus quinine is very effective in malignant tertian infections as sporulation occurs largely in the mesenteric vessels. The absorption of quinine is dependent on physical laws, increasing when as excess of OH-ions is present at the surface of the cell-membrane, and diminishing when an excess of H-ions is present.

Notes on Selective Media for Gonococcus and Pneumococcus (Nand Lal, *Indian Journal of Medical Research*, July, 1925).—In these experiments gonococcus and pneumococcus showed greater yields on trypsin blood-agar and on potato blood-agar than upon simple blood-agar. Gonococcus gave the best yield upon trypsin blood-agar and the addition of potato juice to the trypsin blood-agar made comparatively little difference as compared with trypsin blood-agar alone. Pneumococcus followed the same course as gonococcus more or less closely, but gave definitely the largest yield on potato trypsin blood-agar. The effect of age was to reduce the value of medium from the point of view of yield.

Tryparsamide in the Treatment of Neurosyphilis (Udo J. Wile, M.D., and Lester M. Wieder, M.D., *Journal of the American Medical Association*, June 6, 1925).—Continued observations with a larger number of cases and over a longer period of observation has proved the value of tryparsamide in producing clinical betterment in almost 30 per cent. of a carefully selected group of cases. In the main, clinical improvement was not paralleled by striking changes in the spinal fluid, many of the most strikingly improved patients retaining, after protracted treatment, the changes in the fluid that were found at the original examination. In a small group of cases in which spinal fluid change was noted, clinical betterment was found to be associated with such improvement. When improvement occurred clinically, this was indicated in a large majority of the cases during the first and second course of treatment.

Note on the Incidence of Kala-azar on the Pusa Estate (D. F. Michael, *Indian Journal of Medical Research*, July, 1925).—The climate of Pusa consists of a dry and a moist season; during the dry season, October to May, humidity is relatively low. For a varying period of anything from a week to a month just before the break of the monsoon in June, the air becomes exceedingly hot and dry. The water supply is from masonry wells which are disinfected once a week with electrolytic chlorine. The standing population is made up entirely of the staffs of the various sections of the institute, school, public works department, &c., and their families, and numbers about 800. In addition there is a floating population of about 500, who live in the neighbouring villages. In spite of the good sanitary conditions, &c., kala-azar has made its appearance in Pusa. All the cases that have so far occurred have been among Indians. From observation of these cases the author concludes that kala-azar appears to be essentially a house infection and in a lesser degree a site infection. The disease is undoubtedly associated with unhygienic modes of living. Young children are particularly susceptible to the disease. A point worthy of consideration is that an insect vector is not primarily responsible for the spread of the disease. Its transmission by mechanical means does not necessarily exclude the possibility of a blood sucking insect harbouring the parasite. The incidence of the disease seems to be more marked between the months of October and March and is highest during December, January, February.

The Bactericidal Power of the Blood of Rats as a Measure of their Immunity to Plague (R. H. Malone, C. R. Avari and B.P.B. Naidu, *Indian Journal of Medical Research*, July, 1925).—Using the technique of Heist and Solis-Cohen a definite correlation has been shown to exist between the bactericidal power of the blood of rats and their immunity to plague. The animals experimented upon include (1) rats obtained from the City of Madras, (2) artificially immunized Madras rats, and (3) rats obtained from the City of Bombay; the highly susceptible to plague, the highly immune, and those possessing various grades of immunity inherited or acquired in an endemic plague centre. With the standard test virus employed 2 per cent. of Madras, 33 per cent. of Bombay and 97 per cent. of the immunized Madras rats were found to be immune of plague. Rats of any category which possess a high grade (*a*) of hæmo-bactericidal power are able to survive the test virus and may be considered as immune to plague. In the case of rats from the City of Madras, which as a class have neither inherited nor acquired immunity to plague, a low grade (*c*) of hæmo-bactericidal power indicates certain death in the event of infection with the test virus. Susceptible rats do not respond equally to equal immunizing doses of dead and living plague virus. Seventy-six per cent. develop a high grade (*a*), 18 per cent. a medium grade (*b*) and 7 per cent. a low grade (*c*) of bactericidal power. Three per cent. of those which have survived one standard dose of living plague virus succumb to a second dose. Similar results may be expected in man. While the bactericidal power of the blood serves as a means of measuring the immunity, it is not a true index of the *total* immunity to plague. These experiments have suggested the presence of an additional factor in the immunity of rats to plague, which is probably to be sought for outside the blood stream (tissue immunity, or antiblastic immunity).

As a definite relation exists between the bactericidal power of the blood of rats and immunity to plague, it may be possible by this or some similar technique to measure directly on man the protection likely to be afforded by various kinds of plague vaccines, the proper dosage to be employed, the duration of immunity and the effect of reinoculation, as well as to throw some light on the mechanism of natural and acquired immunity to plague.

Further Observations on Malaria made during Treatment of General Paralysis (Warrington Yorke).—The general bearing which these observations and considerations have on the question of the best means of treating malaria are as follows: Treat the attack with a few moderate-sized doses of quinine and await developments. If a relapse occurs repeat the treatment, and so on. Avoid the use of excessively large doses, or of prolonged courses of quinine; there is no evidence that anything is to be gained from excessive quininization and it may well do harm. Whether or not relapses occur depends on the reaction of the patient himself and on his capacity to develop immune-body, attention to such factors as general health, diet and avoidance of exhaustion are probably of great importance. Whether the systematic administration of daily doses of quinine as a prophylactic is desirable is considered

a very open question. Quinine has no true prophylactic action and it is quite possible that its administration for long periods may render more unsatisfactory the treatment of the infection when it does develop. Probably the point can only be decided by comparing over a period of several years two groups of persons, in one of which quinine is given prophylactically, whilst in the other the attacks of malaria are treated as they occur in the manner described.

Abstracts.

HOOKWORM INFECTION AS INFLUENCED BY THE WEARING OF SHOES.[1]

By Nelson C. Davis.

After studying intensively the problem of hookworm infection in the south-central region of Brazil, Smillie emphasized among other findings a correlation between intensity of infestation and amount of contact with humid earth of the fields. He also pointed out the great protective value of shoe-wearing among the labourers.

The data here presented were collected during a short campaign upon the Ilha dos Marinheiros near the city of Rio Grande on the extreme southern littoral of Brazil. The inhabitants of this island are agriculturists and fisher folk, largely Portuguese immigrants and their immediate descendants.

In a series of 458 cases we made worm counts following treatment. In Table I this series is divided according to sex and age, showing the number of hookworms and ascarides recovered in each subgroup.

It will be seen that the peak of ascaris infestation occurs in both sexes between the ages of 6 and 10 years. It is also noteworthy that the average for the females is greater than that for the males in nearly every age group.

Ignoring for the moment the sharp rise of uncinaria infection in the age group "51 to 55 years," the highest incidence among males occurs in the group "16 to 20 years," the highest incidence among females in the group "11 to 15 years." As will be noticed the curve of infestation rises sharply in the period "6 to 10 years." According to the observation of Smillie, it is during these years that the children of both sexes begin to work in the fields and to acquire their hookworms concomitantly.

Among the male population the average infection remains high up to the age of 60 years. The decided rise at the age of 50 may be eliminated by taking an average of the two groups "46 to 50 years" and "51 to 55 years" giving 169 for the ten-year period. In a similar manner the corresponding groups among females may be averaged, smoothing the curve to 50·9 for the ten years. Averaging these age groups is more or less justified because many of the middle-aged people are ignorant of their exact age and say, "about fifty years"; the nurse then uses his judgment and puts down 50 to 51 years, depending on the age-group to which the individual appears to belong.

Table I.—Average Number of Hookworms and Ascarides per Person at Different Ages.

Age Group years	Males			Females		
	Persons in group	Hookworms per person	Ascarides per person	Persons in group	Hookworms per person	Ascarides per person
1 to 5	29	2·8	7·2	30	4·8	8·3
6 to 10	35	44·1	13·8	25	32·4	20·5
11 to 15	29	137·0	5·7	21	70·4	6·7
16 to 20	40	220·4	1·35	20	64·75	3·3
21 to 25	21	213·6	3·4	22	44·4	7·4
26 to 30	23	197·8	0·18	14	9·93	4·4
31 to 35	19	182·6	2·94	12	8·9	6·0
36 to 40	33	174·8	1·6	12	11·1	4 0
41 to 45	12	185·0	0·25	7	40·4	6·3
46 to 50	11	86·6	4·8	7	9·9	16·0
51 to 55	12	244·6	2·8	11	77·0	1·1
55 to 60	7	164·1	5·6	1	1·0	0·0
Over 60	2	52·0	0·0	3	0·66	0·33
	273	146·7	4·5	185	33·7	8·0

It seems reasonable to suppose that persons attacked by large numbers of worms may appear older than those supporting small numbers, and thus be thrown oftener into the class "51 to 55 years."

Table II considers the same series of cases, subdivided as in Table I, and shows the number wearing shoes at each age. It should be mentioned that a large percentage of the so-called "shoes" are nothing more than wooden-soled slippers. The majority of the field labourers habitually go bare-footed; shoes are not considered necessary, and some types of Brazilian foot gear appear to be an actual hindrance at work.

Although Table II indicates the use of shoes before the age of 15, it is very doubtful if any of these children wear shoes a greater part of the time. A glance suffices to show that shoes are not popular

[1] Abstracted from *The American Journal of Tropical Medicine*, vol. v, No. 1, January, 1925.

among the males in any age group. Before the age of 15 the infection in girls has reached its peak; at about this time many of them either start homes of their own or take up the duties of their mothers, and, with indoor work, begin to wear shoes or slippers more consistently. From the age of "16 to 20 years" onward a fair percentage of the women are found to wear shoes; the infection rate also begins to decline. However, the girls are already infected, and, as Smillie pointed out, it may take several years to lose an infection; hence, the rate remains high up to the age of 25. Beyond the age of 25 there is a sharp decline, and not only is the general rate low, but the rate among the women wearing shoes is appreciably lower than among the others. This difference might be shown in tabular form but the small number in each age group scarcely justifies a subdivision.

Although during the rush of harvest seasons many women of all ages may be found doing farm work, this practice is much more common among those outside the child-bearing age. Many women rear their families to a stage of responsibility and once more take an active part in the out-door work. With their re-entrance into field labours, the women in many instances again discard their shoes. In the age group "46 to 50 years" we find only one woman out of seven admitting the use of shoes; if we average the ten-year period—46 to 55 years—we find 38·8 per cent. wearing shoes.

It is our opinion that the wearing of shoes is the greatest factor influencing the degree of hookworm infestation upon the Ilha dos Marinheiros. It is true that the persons most highly infected are usually the labourers who come into contact with soft, moist earth of the fields, but it does not necessarily follow that these same fields are the source of their infections. Although the native of Ilha dos Marinheiros may sometimes defæcate in the cultivated fields, the custom, as near as we can observe, is to frequent certain very definite localities, for example, a clump of bushes on the uncleared land or a bamboo thicket. The men and women often go to separate places. At the initiation of our work there was not a single latrine among the 1,500 inhabitants of the island.

Table III presents the results of some larval isolation experiments carried out with apparatus and technique comparable to that described by Cort. We always had at hand cultures of human hookworm larvæ for comparison in doubtful cases, but it is improbable that in the samples examined we were able to differentiate the larvæ infective for humans from similar forms potentially parasitic for lower animals.

TABLE III.

Recovery of larvæ from the soil.

Origin of samples	Total samples	Samples positive for Uncinaria	Total worms recovered	Uncinaria larvæ recovered
From public paths and uncultivated door yards	14	3	90	4
Door-step of Post where men cleaned their feet before entering the house	3	3	435	10
Cultivated fields	11	1	313	2
Thickets habitually polluted by the inhabitants	12	9	2,788	67

To account for the great increase of infestation between the age of six and ten years we have but to study the habits of the younger children. Most of the youngsters have not a highly developed sense of modesty and feel no compunctions about promiscuous defæcation. Later they begin to frequent the localities used by their parents and there become infected; this occurs about the same time that they commence to work in the fields. Since the sexes so frequently use separate localities, the girls are not exposed to the same intense soil infestation that falls to the lot of the boys; it is quite likely that this difference would be wiped away in the course of a few years, however, were it not for the protective influence of the shoes more frequently worn by the females.

We are quite aware that these conditions are not general throughout Brazil, or even throughout the State of Rio Grande do Sul. There are farmers in the colonies who deliberately fertilize their fields with human excrement; no doubt such fields are very generally infested, provided the soil conditions are favourable for larval development.

TABLE II.—PERSONS WEARING SHOES, WITH AGE DISTRIBUTION.

Age groups	1 to 5 years	6 to 10 years	11 to 15 years	16 to 20 years	21 to 25 years	26 to 30 years	31 to 35 years	36 to 40 years	41 to 45 years	46 to 50 years	51 to 55 years	Over 55 years	Totals
Males:													
Persons in group	29	35	29	40	21	23	19	33	12	11	12	9	273
Number wearing shoes at work	1	0	3	2	0	2	1	3	0	1	2	3	18
Per cent. wearing shoes	3·4	0	10·3	5·0	0	8·7	4·2	9·9	0	9·9	16·7	33·3	6·6
Females:													
Persons in group	30	25	21	20	22	14	12	12	7	7	11	4	185
Number wearing shoes at work	2	3	9	13	17	8	4	7	3	1	6	4	75
Per cent. wearing shoes	6·7	12·0	42·9	65·0	77·3	57·1	33·3	58·3	42·9	14·3	54·5	52·3	40·5

SUMMARY.

In an analysis of hookworm counts made on the Ilha dos Marinheiros, State of Rio Grande do Sul, Brazil, a rather definite correlation is found between the intensity of infection and the amount of shoe-wearing among the different age groups of both sexes.

It is indicated that infections are contracted in this particular area, not so much by prolonged contact with the humid earth of the fields as by relatively shorter exposure to highly infected spots of pollution.

Although there is an intricate system of paths and trails, there are no real roads on the island. Many paths lead through, or close to, the thickets habitually polluted by the inhabitants. Our table shows that three-fourths of the thickets examined were infested, and that larvæ had no doubt been carried from these areas by the feet of passers-by, secondarily contaminating some of the paths and even the very doorstep of the Post. The cultivated fields, on the other hand, although not extensively examined, appear to have been comparatively free from dangerous contamination. It seems reasonable to suppose that a few minutes spent in a highly infected area would be more disastrous than hours in the open fields. Conditions upon the Ilha suggest those described by Cort as existing in Trinidad.

TWO NEW CASES OF HUMAN CREEPING DISEASE (GNATHOSTOMIASIS) IN CHINA, WITH A NOTE ON THE INFECTION IN RESERVOIR HOSTS IN THE CHINA AREA.[1]

By KAORU MORISHITA and ERNEST CARROL FAUST.

FROM the medical and zoological points of view it is of especial interest that the nematodes of the genus *Gnathostoma*, which are naturally found in various animals, occur occasionally in man, causing disease. Five indisputable cases of *Gnathostoma* in man have hitherto been reported and all from Eastern Asia.

The first case was reported from Siam by Levinsen (1887) who studied a specimen collected by Dr. Deuntzer from the abscess of a native woman and described it as *C. heiracanthus siamensis* n. sp. This was an immature female of *Gnathostoma*. The second case was that of Dr. Kerr in Siam, who removed a parasite from the cutaneous node of a native. The parasite was studied by Leiper (1909) who stated that it was an immature male, identical with that of Levinsen, and must be referred to the genus *Gnathostoma* with the specific name *Gnathosthoma siamense* (Levinsen). Later, Leiper (1911, 1913) discovered that *Gnathostoma siamense* was synonymous with *Gnathostoma spinigerum* Owen (1836), a view which is now generally accepted. The above-mentioned cases, therefore, are concerned with *G. spinigerum*. The parasite of the third case was obtained by Samy (1918) in the Malay States from a thenar abscess of a Chinese coolie and also referred to *G. spinigerum*. The fourth case was reported by Tamura (1919) in Japan. He treated a typical "creeping disease" of a Japanese just returning from a long sojourn in China, and removed a parasite which he referred to *G. siamense* (= *G. spinigerum*). The fifth case was indigenous to Japan and has recently been reported by one of us (Morishita, 1923, 1924). The patient was a male Japanese, 43 years old, who had lived in Tokyo. In 1923 he had "creeping disease" in the left thenar and was operated on by Kinoshita, who excised a part of the cutaneous tissue containing a parasite which was brought to Morishita for identification. The worm, though unfortunately partly damaged, was undoubtedly a young form of *Gnathostoma hispidum* Fedchenko. This species is a parasite generally found in the stomach of the wild and domesticated pigs, and had never been reported before from human beings. This was, therefore, the first case of *G. hispidum* in man.

In addition to these, Ikegami (1919) reported an interesting case from Amoy, China. This case dealt also with "creeping disease" in a male Chinese, caused by a worm which was referred by him to a species of *Echinorhynchus*. From his descriptions and figures the worm seems however to be a young form of *Gnathostoma* and shows a close resemblance to the specimens from the new cases described below. As the parasite in this case is, however, not determined with certainty it is not reckoned by us among the cases of human gnathostomiasis.

Out of the five above-mentioned cases four dealt with *G. spinigerum* and only one with *G. hispidum*. In man they were always found in cutaneous foci, causing abscesses, tumors, or "creeping disease." Furthermore, the specimens which occurred in man were always immature. *Gnathostoma* cannot settle down to develop to maturity in any organ of an unsuitable host like man, but wander in the host's body, especially in the surface region causing various cutaneous diseases. This statement applied also to the new cases which are here recorded.

PROTOCOL OF NEW CASES.

(1) This case was treated by Dr. Fujita of the Hankow Dojin Hospital. The patient was a male Japanese, 26 years old, who went to China in March, 1919, and the following year had "creeping disease" in the region of the right shoulder. On December 13 of that year Dr. Fujita excised the affected part and found a small nematode therein, which he afterwards brought to Morishita for identification. The specimen is a small immature one mounted in balsam.

Description of the Worm.—The body is cylindrical, anteriorly truncated, posteriorly conical, with a maximum length measurement of 2 mm. by 0·29 mm. in maximum diameter which lies a little behind the middle of the body. The head bulb is provided with four rows of single posteriorly directed spines. The number of spines in each row is 40 to 46. The spines measure about 0·01 mm. long by 5 mm. broad at the base. The integument has neither transverse nor longitudinal striations. The cervical sacs are cylindrical with a length of 0·23 mm. to 0·3 mm. The club-shaped œsophagus measures 0·72 mm. long by 0·16 mm. wide in maximum diameter, and is surrounded by the nerve ring about 0·1 mm. from its anterior end. The intestine is fairly regular and is followed by the conical rectum. The anus lies 0·075 mm. from the caudal extremity. We have made observation on the genital organ.

From a merely casual study this specimen carries no body spines; it might seem reasonable to refer it to the genus *Echinocephalus* Molin. But *Echinocephalus* occurs, as a rule, in the intestine of marine fishes, has marine bivalves (*Margaritifera margaritifera*, Pinna, sp.) as intermediate hosts, and has never been seen in mammals. Moreover comparison with the specimen of Case 2, which bears body spines, though very

[1] Abstracted from the *Journal of Parasitology*, March, 1925.

minute, and which shows, excepting this point, a close resemblance in morphology to the specimen of Case 1, leads us to conclude that the specimen in question is referable to a species of *Gnathostoma*, in which the body spines have not yet developed because of immaturity. The clinical details of this case will soon be reported from Dr. Pujita's clinic.

(2) This case was treated at the Hankow Dojin Hospital by the late Dr. Kawano, who obtained a specimen from a male Japanese. The specimen is mounted in blood, now dried and partly damaged, and is labelled "cause of endemic disease." No other data are available. Dr. Fujita, who brought this specimen to Morishita, stated that the "endemic disease" may mean "creeping disease."

Description of the Worm.—The specimen is much shrunken, thick, cylindrical, 1·93 mm. long by 0·44 mm. broad in maximum diameter which lies a little behind the middle of the body. The head bulb, 0·12 mm. long by 0·21 mm. broad, bears four circular rows of spines, and is partly retracted into the so-called circular collar of the body. The number of the spines in each row is about forty. The spines are about 0·02 mm. long by 5 mm. broad at the base.

The integument of the body shows many transverse striations and annulations due to shrinkage. The anterior part for about 0·246 mm. from the cephalic end of the body proper is covered with weakly developed, uncleft, posteriorly directed spines. The œsophagus is thick, club-shaped, and measures 1·04 mm. long by 0·18 mm. broad in maximum diameter. The anus is 0·055 mm. from the caudal tip. The tail projects as a small process. The genital system is still undeveloped. This specimen carries body spines. By reason of this fact the parasite is readily identified as *Gnathostoma*, and excepting this point is closely related morphologically to the specimen of Case 1. Both specimens may, therefore, be assumed to belong to the same species, the specimen of Case 2 being more fully developed than that of Case 1.

As to the specific name of the specimens, however, a definite decision cannot be reached, since they are so young that the structure of the body may be changed and the number of the circular rows of spines on the head may increase with the growth of the body. Notwithstanding, from the cases hitherto reported in man and their distribution, we believe that these specimens may be young *G. spinigerum*.

The nematodes of the genus *Gnathostoma* play an interesting rôle as human parasites. The forms found are always immature and cause only cutaneous diseases, while the adult forms occur in the stomach of the host, also causing pathological changes. These facts warrant the division of gnathostomiasis into two categories: gnathostomiasis externa or cutana for the cutaneous diseases caused by immature *Gnathostoma*, and gnathostomiasis interna for the stomach diseases in animals caused by adult *Gnathostoma*.

In connection with the human cases of gnathostomiasis cutanea recorded from China it is of interest to note the frequency of gnathostomiasis in dogs, cats, and hogs in China. From autopsies on eighty-five dogs from Central and North China only one case of gnathostomiasis was found, numerous gnathostomes, identified as *G. spinigerum*, having been taken from a large stomach tumor. In fifty-eight examinations of cats two have been found positive for this infection. A third positive case has been found by Dr. C. McA. Wassel. Among several hundred hogs examined in Peking and in the Central Yangtze Valley no infection with *G. hispidum* has been observed. The dog and two of the cats found infected were autopsied at Wuchang, across the Yangtze River from Hankow, where the two human cases recorded in this paper apparently incurred the infection. The infection in the third cat occurred in Peking; cat autopsied by Dr. H. E. Meleney.

With reference to the route of invasion of the host it seems not unreasonable to believe that there is a free-living stage which is infective through the skin. The presence of the worms in the cutaneous tissues of man, who is only a semi-suitable host, seems to give a clue in accord with this hypothesis, since after invading the skin such worms were apparently unable to continue their course of migration through to the habitat where the adult worm is wont to develop in the appropriate host.

Conclusions.

(1) Five indisputable cases of human gnathostomiasis have hitherto been reported. Four of these are referable to *G. spinigerum* and one to *G. hispidum*.

(2) Two new cases of human gnathostomiasis from China are added. The new cases deal with very young forms, one of which caused a typical "creeping disease." The other may have also caused the same disease.

(3) Four cases of gnathostomiasis interna are recorded from dogs and cats in China. Three of these were found in cats and one in a dog. One cat was autopsied in Peking. The other infections occurred in the Hankow area.

Current Literature.

Bulletin de la Societe de Pathologie Exotique. June 10, 1925.

A Case of Cerebrospinal Meningitis due to Pfeiffer's Bacillus (Jousset and Girard).—The patient, aged 14 years, was suddenly taken ill on August 8, 1924, with very severe headache and vomiting. He had previously been in very good health, and there was nothing worthy of note in the history of his antecedents. There was stiffness in the neck and abundant diarrhœa. He was taken to the military hospital at Antananarivo the next day. The signs of Kernig and Brudzinski were positive; blood negative for hæmatozoa. Pfeiffer's bacillus was cultivated from the cephalo-rachidian liquid. Most cases of meningitis in Madagascar are due to the meningococcus or pneumococcus, but in this case cultures of both were negative, and antimeningococcus serum had no effect. The patient was

cured and left the hospital September 25, 1924, in very good health.

Yaws at Costa Rica (S. Fallas and T. von Bulow)—Yaws, or framboesia, exists in Costa Rica and is to be found chiefly along the south-west coast of the country bordering on Panama. The natives distinguish it from syphilis and call it "bouba." Clinically, its characters are different from those generally described in yaws. The serologic Bordet-Wassermann reaction is constantly positive. The period of incubation appears to be at least three months. In treatment the arsenobenzols act rapidly on the external manifestations, but complete cure is only obtained by an intensive treatment; the minimum number of doses has not yet been determined.

Treatment of Parasitic Intestinal Affection by Tetrachloride of Carbon in Capsules (Stevenel).—Tetrachloride of carbon in gelatine capsules has proved of great value in the treatment of ascaridiosis and uncinariasis. It is not so expensive as the other medicaments, is more efficacious than thymol, and has a toxic effect on the human organism. In cases of trichocephaliasis, however, thymol is preferred.

Contribution to the Study of "309" Fourneau in Animal Trypanosomiasis (R. van Sageghem).—"309" has proved more efficacious in the treatment of animal trypanosomiasis than "205" Bayer. Its action on *Trypanosome congolense pecorum* and *T. cazalboui vivax* is very rapid. With doses of 2 grm. per 100 kg. of weight the trypanosomes disappear from the peripheric circulation, but relapses occur within seven days.

Mixed Infection by Schistosomum mansoni and S. hæmatobium in a Case of Amœbic Dysentery (E. W. Suldey).—This interesting case of double infection occurred in a child of ten years of age complaining of pain in the abdomen. The child was very weak, anæmic and extremely thin. Examination of the stools showed (1) numerous *Entamœba dysenteriæ histolytica*; (2) *Bilharzia* eggs. Schistosomes were also found in the urine, besides living *miracidiums*. The amœbiasis was soon cured by emetin, but the medicament had no action on the bilharziosis; the dysenteric syndrome, however, disappeared. This case shows the value of microscopical examination of the stools for correct diagnosis.

A Case of Ainhum in the Right Leg (Mme. L. Delanoe).—The patient from the age of three to four years had had suppurating sores on the two elbows and right knee, which spread along the arms and thigh. The right foot began to swell, and later phlyctenæ covered the whole of it; it was very painful. It was diagnosed as a case of ainhum and the operation performed was very successful.

Arterial Tension and Blood Viscosity in Beriberi in the Annamites of Cochin China (M. L. R. Montel and T. van An and Dang van Cuong).—In Annamites suffering from beriberi the arterial tension (maximum, minimum and, above all, differential) is much higher than in normal subjects, and even higher than malarial patients. This increase in the arterial tension is useful in the diagnosis between chronic malaria and chronic beriberi. The blood viscosity is also greater than that found in Europeans.

Urinary Amœbiasis (M. Petzetakis).—Two further cases are described of amœbic cystitis cured by emetin. The patients, aged 35 and 60 years, were both Greeks. The amœbæ found in the urine vary in size, from 10 to 40 microns, and are very often motile. Staining of the amœbæ was not very satisfactory, although various methods were used.

Epidemiological Notes on Oriental Sore in Algeria (L. Parrot and H. Foley).—The number of cases of oriental sore is apparently increasing in all quarters of Algeria. In the region of Tell, cutaneous leishmaniosis has been observed in eight different localities during the last three years; three cases are described in this paper. It is interesting to note that while oriental sore exists in epidemic form in the region of the Sahara, the cases in the region of Tell are sporadic. At Biskra the sores are multiple, at Tell the majority of cases have only one sore; this is accounted for by the great number of insects in the former region.

First Results on the Investigation of Tumours observed in Cochin China (Lalung-Bonnaire and J. Bablet).—During the years 1922 and 1924 anatomopathologic examinations were carried out on 368 hospital patients; of these, 33 had benign tumours and 84 malignant tumours. 90 per cent. of the patients were Annamites. Both sexes are about equally affected. The ages vary between 27 and 72 years. The Bordet-Wassermann was positive in twelve cases; there were eight cases of tuberculosis. Cancer of the stomach is very rare. Epitheliomas originating in the buccal mucus are far from rare. Sarcomas are met with chiefly in children and young men. Lymphoblastic sarcomas of the neck are very frequent and rapid evolution, and often coexist with syphilis. From these observations it is seen that the Annamites of Cochin China are as susceptible to cancer as the white race. All the varieties of malignant tumours have been met with, and the number of epitheliomas of the genital organs is surprising. Tumours of the cervico-facial region are also very frequent and exceptionally malignant.

An Epidemic of Glossitis observed in Senegal (M. Nogue).—The epidemic occurred in December last year in a great number of school children at Dakar. In most cases the lesions appeared only on the tongue; sometimes there was only one plaque and at other times several, varying in colour from pale pink to a bright red. Very rarely the upper lip and the inside of the cheeks are affected. Lesions are frequently to be seen on the labial commisura. In intensive cases the condition is very painful, and there is difficulty in eating and speaking. The condition has no effect on the general health. It appears only in the cold months, but its real origin is as yet unknown; it is a contagious disease. Chlorate of potash in compressed tablets has a remarkable therapeutic action on the condition.

Original Communications.

ON THE IDENTITY OF *GONGYLONEMA SUBTILE* ALESSANDRINI.[1]

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Professor Giulio Alessandrini, of the University of Rome, published, in 1914, in a paper (1914) which has, unfortunately, been largely overlooked by parasitologists, the first well-authenticated record of the occurrence of a nematode of the genus *Gongylonema* as a human parasite. In his paper, which was only a brief preliminary note, intended to be followed later by a full description of the parasite (which, however, has not yet been published), Professor Alessandrini describes the occurrence of six worms in the mouth of a girl near Rome. He indicates his opinion that the species is a new one, for which he proposes the name *Gongylonema subtile*. What is perhaps most interesting of all, he anticipates what we now know, thanks to the researches of Fibiger and Ditlevsen (1914), Ransom and Hall (1915, 1917) and Seurat (1916 *a* and *b*) to be the facts of the life-history of *Gongylonema*, by suggesting that it requires an intermediate host, and that this may be a coprophagous insect. He also wisely remarks that, while no definite pathological effects have hitherto been connected with the occurrence of *Gongylonema* in animals, the view held by Piana that this worm may, by its burrowing, assist the introduction of pathogenic organisms, cannot be lightly set aside.

Following Dr. Sambon's (1925) reference to the work of Professor Alessandrini, the writer communicated with the latter, requesting the privilege of being allowed to examine his extremely interesting specimens. As a result, on the occasion of his presence in London to attend the recent International Conference on sleeping sickness, Professor Alessandrini gave the writer the honour of a personal visit, bringing with him two of the three specimens he had obtained from the case already mentioned.

The writer's study of these two specimens consisted chiefly in taking a series of careful measurements, for comparison with those of the *Gongylonema* occurring in other hosts. All the other recent records of the occurrence of *Gongylonema* in man—Ward (1916), Stiles (1920, 1921), Ransom (1923)—have apparently been concerned with immature specimens, and the specific determination of the worms has therefore been impossible. A very important feature of the case described by Professor Alessandrini is that all the three specimens obtained by him were mature females. It is unfortunate that no male was available, but the examination of adult females makes it possible for the first time to adduce some real evidence of the identity of the species. It has already been suggested by Ward (1916) and by the present writer (1925 *a* and *b*) that the human *Gongylonema* might prove to be identical with *G. pulchrum* Molin of the pig, while, in the writer's opinion, the *G. scutatum* (Müller) of ruminants, and probably other supposed species, are also identical with *G. pulchrum*.

Of the two specimens of *G. subtile* seen by the writer the larger (which may be called specimen A) contained only immature unsegmented and shell-less eggs, of which the largest measured about 0·0375 mm. x 0·0175 mm. The smaller (specimen B) contained a rather limited number of eggs with shells either fully formed or in process of formation, but none of them were quite ripe. There were none in the vagina, and most of the eggs seen appeared (probably through rupture of the uterine walls) to be lying in the body-cavity. The contents of these eggs were either undergoing segmentation or showed early stages in the formation of a vermiform embryo. No fully-formed, coiled embryos were seen, so that none of the eggs were ready for laying. A hitherto unnoticed peculiarity was observed in some of the egg-shells. The shell appeared, in some cases, to be differentiated at each pole into a kind of cap. This character is difficult to see in fully-formed egg-shells of *Gongylonema*, the shell usually appearing entire and of almost equal thickness everywhere. It was found, however, on comparing the earliest uterine eggs from some specimens of the *Gongylonema* of the sheep, that at a certain stage in the formation of the shell, while it is still relatively thin, there may be an appearance as if the poles were formed separately from the middle portion. This appearance becomes obscured later as the thickness of the shell increases. As regards the size of the eggs, Professor Alessandrini informed the writer that his chief reason for regarding *G. subtile* as a distinct species was that the eggs measured by him were only 0·041 mm. in length and 0·028 mm. in width, whereas those of *G. pulchrum* varied from 0·052 to 0·07 mm. in length and from 0·03 to 0·035 mm. in width. The drawing shown to the writer by Professor Alessandrini indicated, however, that the egg figured was an immature one, with unsegmented content, and it may be suggested that the most mature eggs had not been measured. The writer's measurements of the largest eggs of specimen B, as will be seen, are quite in accordance with those of *G. pulchrum*.

The writer's measurements of Professor Alessandrini's specimens are tabulated below, side by side with those of females of *G. pulchrum*, which have been given in previous papers (1925 *a* and *b*). *G. pulchrum* appears to grow larger in ruminants (where it is generally called *G. scutatum*) than in swine. For this reason, in order that the comparison may be quite fair, the measurements of specimens found in pigs and in ruminants are given separately. It should be understood, however, that in the writer's opinion both columns refer to the same species, which has a fairly wide, but continuous, range of variation in size.

It should be mentioned here that each of Professor Alessandrini's two specimens had suffered a rupture of the cuticle at one place in the œsophageal region, and in each case part of the œsophagus

was protruding. In specimen A part of the glandular portion of the œsophagus had been damaged, and for a short distance only its cuticular lining remained. In specimen B the glandular portion of the œsophagus was severed, and a small part of it may have been missing. The rupture of the cuticle appeared to have occurred at the level of the excretory pore in this specimen, and for this reason the position of the pore and of the nerve-ring could not be determined. The measurements of the œsophagus were arrived at by measuring it in sections, including those portions which protruded through the body-wall.

	PULCHRUM		SUBTILE	
	From ruminants	From pigs	Specimen A.	Specimen B.
Length	74—145	37—54·3	55	45·5
Maximum thickness	0·275 —0·53	0·19 — 0·35	0·32	0·38
Anterior end to end of œsophagus	6·6 —9·0	4·5 — 7·3	7·45	7·34
,, end of muscular portion of œsophagus	0·7 —0·95	0·48 — 0·7	0·77	0·81
,, cervical papillæ	0·113 —0·22	0·13 — 0·165	0·18	0·15
,, commencement of alæ	0·19 —0·3	0·19 — 0·24	0·25	0·19
,, nerve-ring	0·25 —0·4	0·275 — 0·29	0·33	—
,, excretory pore	0·53 —0·9	0·46 — 0·575	0·6	—
Length of tail	0 2 —0·38	0·185 — 0·25	0·26	0·22
Diameter of buccal rim	0·0225—0·03	0·025 — 0·03	0·0325	0·03
Length of pharynx	0·04 —0·075	0·05 — 0·625	0·0625	0 06
Cuticular striations, interval between	0·0075—0·0175	0·0125— 0·013	0·015	0·015
Vulva from posterior end	2·64 —7 0	1·75 — 3 135	3·0	2 5
Ova, length	0 05 —0·067	0·052 — 0·07	—	0·058—0·06
,, breadth	0·025 —0·037	0·03 — 0·035	—	0·03 —0·037

It will be seen that the measurements give no ground for assuming that *G. subtile* is distinct from *G. pulchrum*. The evidence might have been still more conclusive had it been possible to examine a male of *G. subtile*. Failing this, however, the writer believes, with all deference to Professor Alessandrini, that this species must fall into synonomy with *G. pulchrum*.

The importance of this conclusion is obvious. We know already that *G. pulchrum* is extremely common in domestic animals in some parts of the world, and we know also that its life-history involves an intermediate host in the shape of an insect. The insects known to be capable of acting in this capacity are several species of cockroaches, the mealworm beetle and its larva, and several kinds of dung beetles of the genera *Aphodius* and *Onthophagus* and their larvæ; while it is extremely probable that various species of *Blaps* are also implicated. The insects become infected by swallowing the eggs of *Gongylonema* contained in the fæces of the final host. These give rise to larvæ which become encapsuled in the insects' tissues, and the final host becomes infected by ingesting, either purposely or accidentally, the infected insects. Since, therefore, the human *Gongylonema* appears to be identical with that of the pig, sheep, goat and ox, it is clear that the chances of human infection are greatly increased by proximity to these animals. All that is necessary is the accidental ingestion of some insect that has fed upon the fæces of an animal infected with the worm, and this may be by no means a rare occurrence where, as in many country districts of Italy, man habitually lives under the same roof with his large domestic animals.

In conclusion, the writer wishes to express his most sincere thanks to Professor Alessandrini for allowing him the opportunity of studying his material, an act of courtesy which, it is believed, may be important in its results.

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ON THE IDENTITY OF *HETERAKIS NEOPLASTICA*, WASSINK.

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Dr. W. F. WASSINK (1916) has given the fullest existing account of the condition known as nodular typhlitis in pheasants, caused by a nematode worm of the genus *Heterakis*. The species of *Heterakis* usually met with in the cæca of pheasants affected

with this disease is considered to be *H. isolonche* von Linstow, 1906. Von Linstow's (1906) original description of this species did not mention any lesions caused by it. Later, however, the lesions were associated with it by Lucet and Henry (1911) who gave a new description of the worms observed by them, which they determined as *H. isolonche*. In addition to the literature dealing with the occurrence of this condition in Europe,[1] an account of its occurrence in America has recently been given by Schwartz (1924), who also determined the worms as *H. isolonche*, but gives no new description of their morphology.

Besides an excellent account of the pathological effects of the presence of the *Heterakis*, Wassink has given a detailed description of the worms found by him. Some of these were of exceptionally large size, and, as a result of his morphological study of them, Wassink was led to suggest that they were of a different species from the *H. isolonche* of von Linstow. He pointed out, at the same time, certain slight differences between the descriptions of von Linstow and of Lucet and Henry, and considered that the latter's specimens were probably not *H. isolonche*, but belonged to the same species as his own. To this, in a later publication (1917), he has given the name of *H. neoplastica*.

Through the kindness of Dr. Wassink, and of Dr. C. Bonne of the Nederlandsch Kankerinstitut, Amsterdam, the writer has had the opportunity of examining specimens of the worms found by the former. A comparison of the various descriptions had already given rise to some doubt as to the validity of the new species, and it may be said at once that this doubt has not been removed by a study of the material. In the writer's opinion, *H. neoplastica* should be regarded as synonymous with *H. isolonche*. The following table shows the measurements (in millimetres) given by Wassink, by Lucet and Henry, and by von Linstow respectively. (The measurements in square brackets have been calculated from figures expressed by von Linstow as fractions of the total length.)

	Author and date :— Wassink, 1916		von Linstow, 1906		Lucet and Henry, 1911	
	♂	♀	♂	♀	♂	♀
Total length	15·0	17·0	7·8	9·3	7·5 —9·0	9·0 —12·0
Maximum thickness	0·55	0·6	0·48	0·47	0·38—0·4	0·425— 0·47
Length of œsophagus (including bulb)	1·9	2·1	[1·15]	[1·1]	1·2 —1·35	
Length of œsophageal bulb	0·37		—	—	—	—
Width of œsophageal bulb	0·21		—	—	0·26—0·3	
Length of tail	0·64	1·2	[0·6]	[1·29]	—	—
Length of spicules	1·8		1·41	—	1·4—1·75	—
Distance of sucker from posterior end	0·95	—	—	—	—	—
Diameter of sucker	0·14	—	—	—	—	—
Length of eggs	0·065—0·067		0·073		0·07 —0·075	
Width of eggs	0·035—0·04		0·044		0·042—0·046	

It should be mentioned that the hosts from which von Linstow and Wassink obtained their material were chiefly golden pheasants (genus *Thaumalea* [=*Chrysolophus*]). The birds studied by Lucet and Henry were Manchurian pheasants (*Crossoptilum manchuricum*) and a common pheasant. Wassink's largest specimens, upon which his description is based, appear to have come from hybrids between two well-marked varieties of the golden pheasant, known as *picta* and *obscura*.[2]

In order to complete the measurements given by the earlier describers, for comparison with Dr. Wassink's specimens, the writer has taken a few additional measurements from specimens determined as *H. isolonche*, from the Indian horned pheasant (*Tragopan satyra*) and Monál (*Lophophorus impeyanus*). These specimens were of average size (not exceeding the total lengths given by Lucet and Henry).

The dimensions of the œsophageal bulb were found to vary from 0·25 mm. × 0·17 mm. to 0·3 mm. × 0·25 mm. in males, and from 0·24 mm. × 0·19 mm. to 0·3 mm. × 0·25 mm. in females. (The first figure given in each case is the length, the second the width. The former cannot be very accurately measured, as the passage from the cylindrical portion of the œsophagus into the bulb is gradual, and the slight difference in histological structure between the two parts is not always very apparent.) The length of the tail in the males varied from 0·5 to 0·6 mm., and in the females from 0·95 to 1·35 mm. The diameter of the caudal sucker of the male ranged from 0·09 to 0·13 mm., and its distance from the posterior extremity from 0·6 to 0·76 mm.

The specimens kindly submitted by Dr. Wassink for examination comprised three males and five females. The largest male was about 13 mm. long, the largest female about 15 mm. The detailed measurements of these eight specimens were in general agreement with the figures published by Dr. Wassink, but showed a considerable degree of variation, and sometimes even exceeded his maxima. Thus the lengths of the œsophagus (including bulb) were as follows: males, 1·6, 1·75, 1·85 mm.; females, 1·75, 1·75, 1·9, 1·9, 1·95 mm. The length of the œsophageal bulb varied from 0·4 to 0·45 mm., and its width from 0·25 to 0·3 mm. The tail of the male varied in length from 0·7 to 0·8 mm., that of the female from 1·52 to 1·75 mm. The suckers of the three males were respectively 0·13, 0·14 and nearly

[1] Full references to the earlier literature will be found in the papers of Lucet and Henry, Wassink and Schwartz.

[2] These forms are not now generally regarded by ornithologists as specifically distinct.

0·15 mm. in diameter, and situated at 1·06, 0·96 and 0·9 mm. from the tip of the tail.

It will be seen from these measurements that, apart from the fact that some of Dr. Wassink's specimens were unusually large, and that the dimensions of their parts were more or less proportional to their total length, there is really a considerable amount of variation throughout the series, and that it is unsafe to assume that the extremes represent specific differences.

Taking in order the points of supposed difference between Dr. Wassink's *Heterakis* and *H. isolonche*, we have to consider:—

(1) *The total length of the worms.*—Dr. Wassink's measurements are admittedly derived from a single male and a single female, and these were evidently two of the largest available. Judging from the accounts of individual cases, they came probably from Case IV or Case V, which were hybrid golden pheasants. In Case I (apparently not a hybrid) the maximum lengths observed appear to have been 13 mm. (female) and 9 mm. (male), and these are scarcely above the average for *H. isolonche*. Probably every helminthologist will recall instances of considerable variation in size met with between different collections of nematodes of the same species, particularly if they came from different host-species. It is, in fact, noticeable that nematode parasites habitually grow larger in one kind of host than in another, and it seems conceivable that in the present instance there is some factor in the offspring of crosses between the two varieties of pheasants that specially favours the growth of the worms. It is of great interest to notice that Dr. Wassink also found, in some of his pheasants, specimens attributed to the common *H. papillosa* of exceptionally large size (males 15 mm., females 17 mm. in length).

(2) *The spicules of the male.*—Dr. Wassink points out that in his specimens the spicules, when extruded, were crossed, and that in this they agreed with Lucet and Henry's figure and not with von Linstow's. It is true that when far extruded the spicules are frequently crossed, but this is not so in all specimens even in the same batch, and in any case von Linstow's figure shows both spicules pushed to one side in an unnatural manner, and this has evidently been brought about by manipulation, such as pushing the cover-glass in order to roll the tail into a suitable position for drawing. Dr. Wassink further notes that there is a marked difference in shape and width between the right and left spicules in his specimens. In those sent to the writer, the spicules were always retracted, but in the writer's own examples the left spicule is somewhat longer than the right, has a thicker shaft and much broader alæ.

(3) *The cuticular striations.*—Wassink observes that his specimens agree with those of Lucet and Henry in having transverse striations, which were absent in von Linstow's specimens. Von Linstow, however, although he uses the expression "Cuticula glatt," does not state definitely that striations were absent, or even that he could not detect them, though the latter may very well have been the case. The striations are often very faintly indicated, especially in well-extended specimens, and in the examples studied by Lucet and Henry they are said to have been placed at intervals of not more than 2 microns.

(4) *The caudal papillæ of the male.*—Lucet and Henry appear to have overlooked a small postanal pair of subventral papillæ, which may, owing to their position, have been hidden by the spicules, if the latter were always extruded as in their figure. Otherwise all the descriptions, as regards the number and arrangement of the papillæ, are quite easily reconciled.

(5) *The "papillæ" in the vulvar region of the female.*—It is mentioned as a point of resemblance between Wassink's *Heterakis* and that of Lucet and Henry that, in addition to several papillæ behind the vulva, there is sometimes one in front of it, whereas von Linstow states that there are two or three behind, and mentions none in front. These "papillæ," however, as has been pointed out by Baylis and Daubney (1922, p. 289) for *H. isolonche*, and by Baylis (1923, p. 11) for *H. monticelliana*, are very variable in number and position, some females (especially the younger specimens) having none. There can be very little doubt that they are actually caused by the suckers of the males in attempting copulation, and they cannot, in the writer's opinion, be regarded as a specific character.

For the reasons that have been detailed, the writer concludes that the proposed separation of *H. neoplastica* from *H. isolonche* is not justified, the facts showing only that there is a greater amount of variation in size between individuals of *H. isolonche* than had been observed prior to the appearance of Dr. Wassink's work.

For their courtesy in affording facilities for the study of this interesting question, the writer wishes to express his sincere thanks to Dr. Wassink and Dr. Bonne. Thanks are also due to Dr. Sambon, who brought Dr. Wassink's work to the writer's attention.

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A CONTRIBUTION TO THE STUDY OF THE RADULÆ OF FRESH-WATER MOLLUSCA.[1]

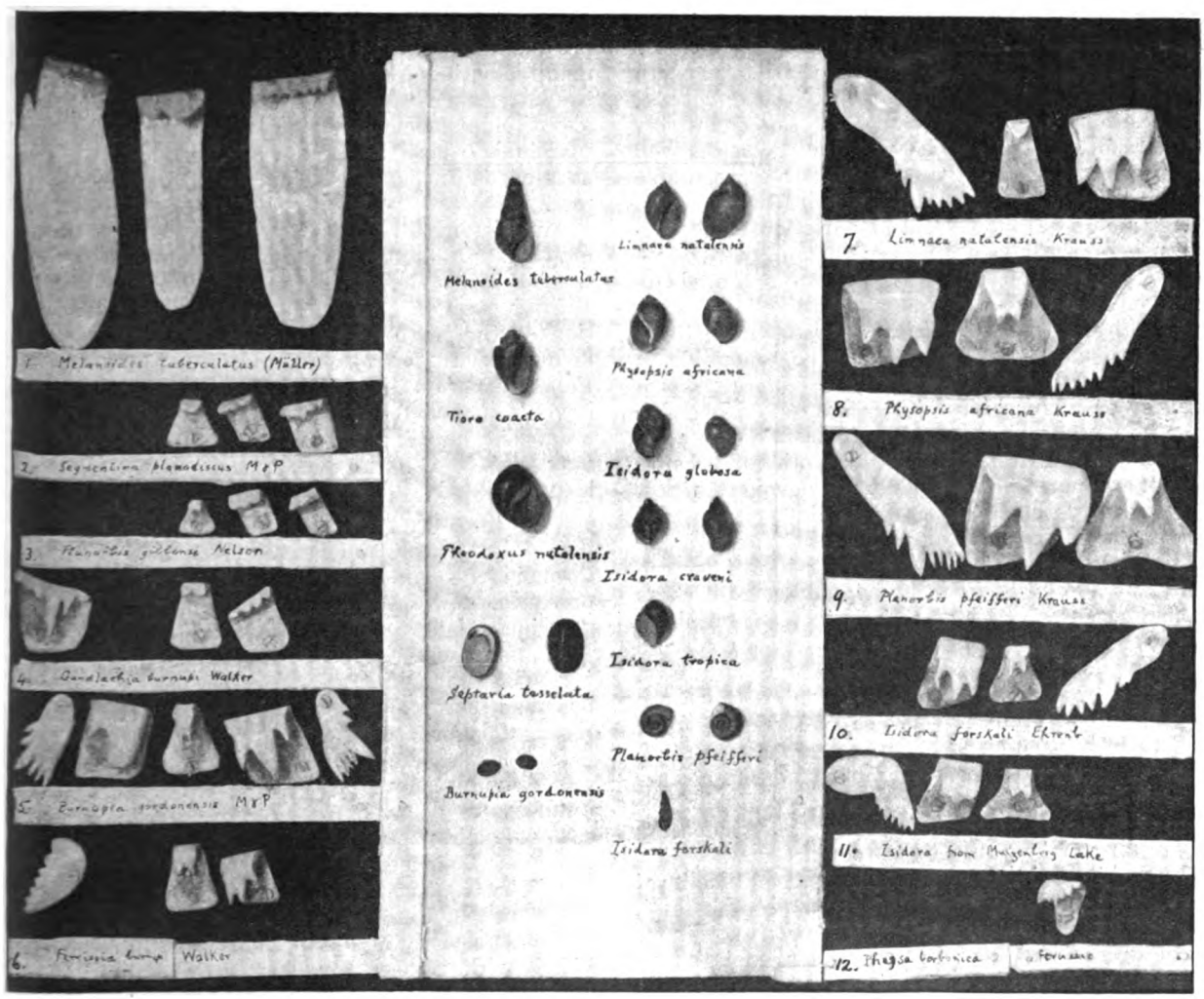
By F. G. Cawston, M.D.

Considerable interest has been added to the study of those fresh-water mollusca of South African swamps which serve as intermediate hosts of the trematode parasitic worms, since a careful microscopic study reveals the fact that the identity of some species may be determined partly by the appearance of the teeth.

If an example of our fresh-water mollusca is set aside in a clean glass test-tube containing a little appropriate food, it is possible to observe the ribbon-like structure containing the teeth scratching the surface of the food like a rasp.

In order to determine the characteristic appearance of the teeth, it is necessary to examine the radulæ at the various stages of development. Microscopically, teeth characteristic of the adult radula are to be seen even in the embryonic radula.

Unlike some species which possess the same number of teeth in each row, each of our hosts



Photographic plate, showing lead models of typical teeth of various fresh-water and lagoon mollusca, made from camera-lucida sketches. (No. 1, × 500; Nos. 2, 3 and 7 to 12, × 375; Nos. 4 to 6, × 750; shells, half natural size.

The teeth are attached to a ribbon-like structure called the radula; this is broader in fresh-water species than is usual with lagoon and land species, where it is more often curled up and shaped like a watch-spring.

for trematode parasitic worms, with the exception of *Melanoides tuberculatus* (Müller), has rows in which the number of teeth varies, and, as there are from 120 to 150 rows of symmetrically placed teeth, with as many as 50 teeth in all but the most anterior rows, the majority of mature individuals possess from 7,000 to 10,000 teeth.

The teeth are arranged like a harrow, and, if seen

[1] **Read before the Congress of the South African Association for the Advancement of Science, at Outshoorn, C.P., July, 1925.**

from the side, many of the individual teeth present the appearance of a finger-rest or picture-hanger.

The teeth of *Oncomelania nosophora* Robson, the intermediate host of *Schistosomum japonica* Katsurada, like those of *Tomichia ventriculosa* (Sowerby) Reeve from Muizenberg, C.P., present small ridges from which cusps arise. In the South African hosts for schistosoma, these ridges have developed into broad overhanging processes—the "crown" of the tooth. Many of these crowns are a quarter of the size of the whole tooth. At the marginal border of the radula, the cones which grow from the edge of the crown of each tooth consist of a number of small denticles; so that the elongated crowns present the appearance of outstretched human hands. As the centre of the radula is approached, these denticles tend to coalesce, so that the lateral teeth possess but three undivided cones, the endocone, the mesocone and the ectocone. The relatively great breadth of the radulæ of these species is well suited for covering a large surface of their vegetable food. Although, in different examples of the same species, there is a good deal of variation in the appearance of the cones, the crown and basal plate are remarkably constant. Except for the angle of the basal plate, it is not possible to tell the marginal teeth of *Physopsis africana* Krauss from those of *Limnæa natalensis* Krauss; nor is it possible to differentiate them from those of *Isidora tropica* (Krauss) or *Planorbis pfeifferi* Krauss. Nevertheless, the central tooth of *L. natalensis* can readily be distinguished from that of the others, because it is tall and narrow and is generally devoid of cones. The central tooth of *P. africana* is almost triangular and usually possesses two cones, whilst the bicuspid central tooth of *I. tropica* and *P. pfeifferi* is constantly broader still. The individual teeth of these species measure 1/30th mm. in height. Careful examination that I have made of several thousand teeth has failed to reveal the presence of decay. Indeed, it would appear that the more the teeth are used to scratch the surface of food the more perfect they become.

As development proceeds, more and more rows of teeth are added posteriorly and more and more marginal teeth appear in each row, thus increasing the length and breadth of the radula.

The habit of boring holes through the shells of other mollusca results in much injury to the teeth of *Rhaciglossa* and accounts for the extraordinary length of their radulæ; however, this habit is unknown amongst the cercariæ-carriers of South African rivers. It is difficult to understand why some other species possess such long radulæ; this is very evident in some lagoon species. It is very unlikely that the posterior portion of these radulæ are ever brought into play except in those rare instances where the anterior portion has been torn off by crabs or by other natural enemies in the lagoons. Such an occurrence must be exceedingly rare in fresh-water species, in view of the rapidity with which the foot is withdrawn into the shell at the slightest sign of danger.

The intermediate hosts of South African trematoda feed on waterweeds and are less exposed to attacks from their natural enemies than lagoon species. Lagoon inhabitants feed on coarser food and suitable teeth are provided. Many of the small Planorbinæ have teeth with well-marked cusps, but without cones. Elongated cones are more liable to injury from coarse food than the short cusps. The cones of *M. tuberculatus* (Müller) can be bent back without breaking them.

A careful examination of the radula of some examples from Mauritius which had been identified for me as *I. borbonica* Férussac revealed about 120 rows of almost identical teeth, each provided with about six small cusps. The species represented proved to be *Physa borbonica* (Férussac) which is readily distinguishable from *I. tropica* Krauss; for the latter species possesses a central bicuspid tooth, about eight tricuspid laterals and from 18 to 21 marginals whose cones are divided into as many as nine denticles, one being much larger than the rest.

Amphistoma were isolated from South African mollusca first at Potchefstroom in 1918. The species responsible being identified by Mr. H. C. Burnup as *I. schakoi* Jickeli. From an examination of the teeth, the species would appear to be identical with *I. tropica* Krauss, as Monsieur Paul Pallary considers it to be. Since then amphistoma have been isolated from *I. tropica*, *I. forskali*, *I. natalensis* and *I. craveni* Ancey. The last species may also be a variety of *I. tropica* and possesses identical teeth.

Conclusions.

(1) The central and lateral teeth are the first to form in the embryonic radula. As development proceeds, new laterals are formed from the inner marginals, by a coalescence of their denticles.

(2) Fresh-water species are exposed to less injury than the inhabitants of brackish water in lagoons; their radulæ are broader and shorter than those of lagoon species.

(3) The large number of rows of teeth in fresh-water mollusca are provided, not because of their tendency to decay or to be worn out in the exercise of their natural functions in eating, but because of their constant exposure to injuries, the loss being replaced by the posterior rows. For the same reason, those mollusca which use their teeth to bore holes through the shells of others are provided with remarkably long radulæ, while land and lagoon species, which are constantly exposed to the attacks of their natural enemies, are also provided with longer radulæ than those commonly possessed by the inhabitants of semi-stagnant rivers and still pools.

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Annotations.

Pathogenesis of Epilepsy (Aldo Massaglia, M.D., *The Journal-Lancet*, July 15, 1924).—The experiments reported determined in the animals a morbid condition which may be compared with, if not considered equal to, some forms of epilepsy. The results lead to the supposition that some forms of the disease (epilepsy) may be caused by a hypofunction of the parathyroid glands, which create the predisposition to the convulsive attack, accompanied by a hypersecretion of the islands of Langerhans which lowers the blood-sugar content. It is suggested, then, in cases of idiopathic epilepsy, to try using a treatment based upon the administration of parathyroidin and sugar—a treatment which will probably induce a cure.

Amœbic Abscess of the Liver. Report of a Case Complicated by Subphrenic Abscess (*Journal of the American Medical Association, June* 27, 1925).—It is considered that it might be possible to treat a liver abscess successfully, but the destruction of the liver is so extreme that the patient dies as a result of lack of liver tissue. In the last ten years, at the University Clinic at Philadelphia, there has been one case of amœbic abscess of the liver and seven cases of subdiaphragmatic abscess. In the same length of time there occurred eight ordinary abscesses of the liver. The clinic has been much interested in the work done by the roentgenologic department. One cannot depend on the position of the diaphragm in the differentiation of a liver abscess from a subdiaphragmatic abscess. Exploratory puncture, starting high in the chest wall, to rule out empyema, which complicated subdiaphragmatic or liver abscess in three cases, is ardently advocated. Following operation, a small bronchoscope through the transpleural opening has been used. Another point of interest is that it is believed that subdiaphragmatic abscesses start as liver abscesses.

The Nutrition of Mycorrhiza Plants: Calluna Vulgaris (M. C. Rayner, D.Sc., *British Journal of Experimental Biology*, January, 1925).—An interesting account is given of the formation and seasonal development of mycorrhiza in Ling (*Calluna vulgaris*). A record was obtained for the first time of the digestion of the intracellular complex of mycelium in the mycorrhiza cells and the cytology of the process is described. Fresh information of the distribution of the endophyte in the shoot tissues was obtained, and confirmed by experimental work on cuttings struck in sterilized sand under controlled conditions. The endophyte was recovered and identified from the shoot. These results are compared with those described by Christoph, whose observations were interpreted in the light of the account now given of the information of "suppressed mycorrhiza" in roots of cuttings and also in those of seedlings and mature plants when certain conditions exist in the rooting medium. It is pointed out that the "obligate relation" in *Calluna* is associated with *infection and seedling development* and not with *mycorrhiza formation and growth*. The view is expressed that plants would probably grow quite well without mycorrhiza could seedlings be raised free from infection. The formation of mycorrhiza in all roots is the rule of nature; the activities of endophyte and its digestion products are presumably related to the nutrition of the plant and may be correlated with its growth in particular soils. Evidence for exchange of nutritive material is given. The view has been reached that such exchange exists, with a "balance of profit" on the side of the vascular plant. It is suggested, in view of its application to cases for which experimental data are not available, that the term "symbiosis," as applied to mycorrhiza plants, should be used in the older sense defined by de Bary.

The Feeding Habit of Termite Castes and its Relation to their Intestinal Flagellates (L. R. Cleveland, *Biochemical Bulletin*, No. 5, May, 1925).—The conclusions of this paper are: At every stage in the life-cycle of any caste where wood is eaten, protozoa are present. When wood is not eaten or obtained in some way, protozoa are never present. Second and third form young adults have lost the ability to eat wood. The protozoa in these castes disappear concomitantly with the loss of the ability of their host to feed on wood, and by the time the wood-eating ability is lost, they have all disappeared. This occurs about the time of the final moult and is perhaps brought about by the feeding of salivary secretions which take the place of the wood diet. In all castes, the protozoa are lost during moulting, but they are soon regained, except in the final moult of the second and third forms, in which forms they are never regained because, owing to the degeneration of their jaw muscles, these forms have lost the ability to eat wood. What causes jaw muscles to degenerate is not definitely known. It may be inherent in these castes, as much a part of them as anything else. If it is, then the salivary-feeding is hereby made necessary and takes the place of the wood diet when the jaw muscles degenerate. But a more plausible possibility is that these forms are fed on so much salivary secretion that they cease to feed on wood, and because of this their jaw muscles degenerate through

disuse, and thus the ability to feed on wood is lost forever. The first form and the worker always eat wood, except in the post-adult stage of the life-cycle of the first form where it, too, after having attained an old age, loses the ability to eat wood and becomes dependent on the workers and young undifferentiated nymphs (when present) which it has reared. It is noteworthy that mostly workers are raised in the first brood. Adult soldiers, owing to their large mandibles, cannot eat wood (cannot chew it) though they obtain it, together with protozoa from the ani of the xylophagous members of the colony. Soldiers, like workers, harbour protozoa throughout their life-cycle. Young soldiers (soldier nymphs) before they obtain the large mandibles, can chew wood for themselves. So can the second and third forms, during early life. A caste which cannot eat wood, or, thinking in terms of the protozoa, a caste which does not harbour protozoa, cannot live by itself. Such individuals are dependent on the wood-eating members of the colony for support; consequently adults of the second form, third form and soldier castes must be supported by other members of the colony. But the soldiers, in one sense, are not as difficult to support as the second and third forms, since they can digest for themselves the partially digested woody material which has passed through the alimentary canal of the xylophagous members of the colony before they receive it; while the second and third forms, since they feed exclusively on the salivary secretions, must subsist entirely on predigested food.

Contributions to Pathologic Anatomy of Syphilis. I. Syphilis of the Aorta (Edward L. Miloslavich, M.D., *Archives of Dermatology and Syphilology*, July, 1925).—Syphilis of the aorta is a morphologically characteristic disease which is localized in the elastic-muscular layer (mesaortitis) at the most proximal portion of the aorta, and which leads to an aortic insufficiency, occlusion of the coronary arteries and formation of aortic aneurysm. Syphilis of the aorta plays a dominant part in the pathology of syphilis. The syphilitic nature of this aortic disease is proved: by the presence of syphilitic histologic lesions (gummatous infiltrations); by the demonstration of *Spirochæta pallida* in the diseased aortic wall; by the positive reaction of the Wassermann test made on the blood taken during necropsies; by the frequent combination with other syphilitic organic diseases, such as syphilis of the central nervous system (general paralysis, tabes dorsalis, &c.), syphilis of the liver, testes, &c.; by its appearance at a relatively early age, and by its characteristic macroscopic and microscopic localization in the aorta itself, as compared to the localization of atherosclerosis of the same organ.

Toxicity of Oxygen for Protozoa in Vivo and in Vitro: Animals defaunted without Injury (L. R. Cleveland, *Biochemical Bulletin*, June 6, 1925).—The toxicity of oxygen at various pressures for four genera of termites has been determined. At a pressure of 3·5 atmospheres the protozoa are all killed in two genera in thirty minutes, one in thirty-five minutes and in another in forty minutes, while the termites themselves are not killed until forty-five hours. Thus, oxygen is more than forty times as toxic for the protozoa as it is for the termites. This makes it possible to remove all protozoa from termites very easily and without injury to the host. The protozoa of two termite genera were not killed at one atmosphere of oxygen even in ten days, while in two other genera they were killed in one and three days respectively. Cockroaches harbour many kinds of protozoa, all of which were removed by oxygenation at 3·5 atmospheres in three and a half hours. It is highly probable that all insect-inhabiting protozoa may be removed by oxygenation without injury to their hosts. If so, the rôle which insects play in the transmission of protozoa from man to man, from animal to animal, from animal to man and from plant to plant can be worked out much more effectively. Earthworms when oxygenated lose their ciliates and are uninjured by the process. Frogs harbour many protozoa. More than 150 experiments have been carried out on the oxygenation of frogs and all the intestinal protozoa may be removed without injury to the frogs. The protozoa of two water-breathing vertebrates, goldfish and salamanders, were all killed by oxygenation in less than one fifth of the time required to kill their hosts. It is highly probable that all intestinal flagellates and ciliates may be removed from all invertebrates and from all cold-blooded vertebrates by oxygenation and that none of these hosts will be injured. It is also possible that the sporozoa, amœbæ and blood-inhabiting protozoa may be removed from the same hosts in the same way and without injury to the hosts. Oxygenation experiments have been carried out on four genera of free-living ciliates and two of free-living flagellates. Oxygen is certainly just as toxic for some free-living ciliates as it is for parasitic ciliates; for others it is not. Oxygen in excessive amounts is toxic for all animals, but protozoa possibly take up a correspondingly larger amount of it as the tension or pressure is increased than do higher animals and for this reason are affected more adversely than termites, cockroaches, earthworms and frogs.

Urticaria Solaris. Report of a Case (L. G. Beinhauer, M.D., *Archives of Dermatology and Syphilology*, July, 1925).—The case reported is interesting because it deals with a skin reaction produced by exposure to the sunlight. The reaction was a typical urticarial wheal, which could be duplicated by exposure to the ultra-violet rays of the mercury-quartz lamp. Other efforts to produce this reaction failed, making it evident that some rays from the sun and some rays produced by the mercury-quartz lamp were similar, producing the same reaction. As in other cases reported along similar lines, the

patient belonged to an "allergic family." From the data obtained the author feels sure he is dealing with a specific sensitization of this patient's skin to the near ultra-violet rays.

The Effects of Oxygenation and Starvation on the Symbiosis between the Termite, Termopsis and its Intestinal Flagellates (L. R. Cleveland).—The results of these experiments, as regards the symbiotic relationship between termites and their intestinal protozoa, are in accord with those obtained by the incubation method (Cleveland 240). The symbiosis between these insects and their intestinal flagellates has now been clearly demonstrated by three entirely different methods, namely, incubation, starvation and oxygenation.

Lupus Erythematosus (Binford Throne, M.D., *Archives of Dermatology and Syphilology*, July, 1925).—In early cases of the discoid type, removal of focal infections before atrophy sets in, together with simple local treatment, seems curative. When atrophy is present, removal of focal infections has no curative value. Removal of focal infections before instituting radical treatment seems to prevent recurrences. Vaccine treatment was of no value. The blood complement-fixation test for tuberculosis seems to be of value in the diagnosis of the tuberculids. In lupus erythematosus a negative result is to be expected.

Dermatitis produced by the Portuguese Man-of-War (E. D. Crutchfield, M.D., July, 1925, *Archives of Dermatology and Syphilology*, July, 1925).—The tentacles of the Portuguese man-of-war contain an irritant substance capable of producing an acute dermatitis. The dermatitis varies from an urticarial line to a linear coagulation necrosis, varying with time of contact. The acute symptoms of the disease are alleviated by the application of weak antacid solutions. The lesions heal, leaving a hæmatogenous pigment, which is slowly absorbed. In some instances healing is followed by permanent scar formation.

Congenital Ichthyosiform Erythroderma (Richard S. Weiss, M.D., and Norman Tobias, M.D., *Archives of Dermatology and Syphilology*, August, 1925).—Six cases of congenital ichthyosiform erythroderma are reported equally divided between the sexes. The earliest time of appearance was at the age of two months, the latest at nine years. In four of the cases there was distinct familial tendency. The evidence in the literature, as well as in these cases, leads one to believe that there should be no differentiation between the wet and dry types, as the wet types seem to represent a superimposed bullous impetigo. Possibly some of these cases may indicate a transitional type of epidermolysis bullosa with elastic tissue changes. The pathology is similar to that of ichthyosis vulgaris. The cellular infiltrations in the corium are in all probability secondary to external irritation with resulting inflammation.

Dermatitis in Association with Disease or Injury of the Peripheral Nerves (S. William Becker, M.D., *Archives of Dermatology and Syphilology*, August, 1925).—A case is reported of eczematoid dermatitis of the right side of the face, appearing three weeks after section of the posterior root of the gasserian ganglion. Herpes at no time was suggested. Pyorrhœa and dental caries were also present on that side. The condition was little influenced by treatment, and had been present for about four years. Experimental and clinical observations would seem to indicate that toxic, infectious or mechanical irritation of the sensory nerves can be instrumental in producing this type of lesion.

Nodosites Juxta-Articulaires (Perpetuo D. Gutierrez, M.D., *Archives of Dermatology and Syphilology*, August, 1925).—All the cases treated yielded, though slowly, to neoarsphenamin. In some two injections sufficed to reduce a tumour of the size of a pigeon's egg to that of a pea. These patients, however, improved so much and the tumours were so reduced in size that they failed to return for further treatment. After the first injection, there was not much reduction in the size of the tumours; there was only softening of the hard cartilagenous consistency. On subsequent injection, however, the reduction in the size was marked.

Notes on Ornithobilharzia Odhneri n. sp. from the Asiatic Curlew (Ernest Carroll Faust, *Journal of Parasitology*, Reprinted, September, 1924).—A new species of avian schistosome, designated as *Ornithobilharzia odhneri*, is described from the curlew *Numenius arquatus*. The details of structure, particularly in the female worm, require certain amendments in the generic concept. The presence of Laurer's canal in *O. odhneri* with a direct opening to the dorsal surface, would make it seem likely that the organ may actually function for the reception of sperm directly from the male.

Studies on the Etiology of Heartwater. Rickettsia Ruminantium in the Tissues of Ticks Transmitting the Disease (E. V. Cowdry, *Journal of Experimental Medicine*, August 1, 1925).—The evidence offered in the studies indicative of a causative relationship between *Rickettsia ruminantium* and heartwater is supplemented by the following observations concerning the ticks which carry the disease. When larvæ, which had taken no food since hatching, were allowed to feed upon cases of heartwater, it was found they acquired rickettsiæ, which appeared to be identical with those in the tissues of animals suffering from heartwater, whereas control larvæ hatched from eggs deposited by the same female and fed on normal

animals, remained free of *Rickettsiæ*. After larvæ presumably infected had moulted the resultant nymphæ containing rickettsia in their alimentary tracts, when fed upon susceptible animals produced in them typical attacks of heartwater, which the control nymphæ, devoid of rickettsiæ, failed to do. The tissues of animals thus infected were found upon histological examination to contain typical rickettsia.

Studies on the Etiology of Heartwater. Observation of a Rickettsia, Rickettsia Ruminantium in the Tissues of Infected Animals (E. V. Cowdry, *Journal of Experimental Medicine*, August 1, 1925).—A Gram-negative, intracellular, coccus-like micro-organism was found in cases of heartwater in the three species which are susceptible to the disease, namely, goats, sheep and cattle. It was absent in the case of control animals, both normal ones and those dying of some other diseases. The presence of this micro-organism was definitely related to the febrile reaction. It was most easily detected in the renal glomeruli and in the small capillaries of the cerebral cortex, but probably occurred throughout the body. The micro-organism was a typical endothelial parasite, being restricted in distribution to the endothelial cells of the smaller blood-vessels and to portions of such elements which had broken off into the blood-stream. It was never observed to cause injury to the cells other than those incident to mechanical distension through accumulation within them of many individuals in large, densely packed masses which were characteristically spherical. A typical attribute was the presence of several of these masses within the cytoplasm of a single endothelial cell. In view of the association of this micro-organism with heartwater, a disease of ruminants, and thus far the only one in which micro-organisms resembling rickettsiæ have been reported, the designation *Rickettsia ruminantium* is proposed.

The Relation of the Vitamins to the Reaction induced by Coal Tar in the Tissues of Animals (Louis H. Jorstad, M.D., *Journal of Experimental Medicine*, August 1, 1925).—Drops of coal tar introduced into the subcutaneous tissue attract the fibroblasts, endothelial and other cells to them. These cells suffer degenerative changes through this action of the tar and the animal suffers cachectic-like changes and death from large doses of it introduced into the subcutaneous tissue. This action of the coal tar is limited to a short period of time, after which it becomes inert. The cells which have been drawn to it and which have not completely degenerated then slowly recover. Where large numbers of cells are drawn to the tar they grow and divide after recovering from the initial effects of the tar. Cancer may develop. Where only a few cells are drawn to the tar they lay down intercellular fibrils and a scar eventually develops. Vitamin A fed in more than ample quantities to these animals protects the animals and the cells against the toxic action of the tar and stimulates and prolongs their secondary growth. Vitamin B stimulates the secondary growth of these cells. This action is limited in extent and time. It is followed by an early degeneration and hyalinization of the tissue.

The Anticryptogamic Action of Fluosilicate of Soda and of Hydrofluosilicic of Acid in the Coagulation of India-rubber (A. Lambert, *Arch. des Instituts Pasteur d'Indochin*, April, 1925).—In the author's experience, the fungicide action of hydrofluosilicic of acid and of fluosilicate of soda is not sufficient to completely hinder the development of moulds; their development and fructification, however, are delayed. It is thought possible that in a "séchoir" where the conditions of humidity are less favourable, this delay can be sufficient for the humidity of the gum and the atmosphere to become such that the development of the moulds cannot be produced. The fungicide action of fluosilicate of soda is superior to that of fluosilicic of acid. The coagulation of the former by suspension in water is better than that obtained by powdered salt; with the latter method, the latex must be poured on the salt and not the salt on the latex. The chemical composition of the two samples of gum is much the same; only a slight increase in the ashes and a decrease in the resin are observed in the fluosilicate coagulated sample. The coefficient characteristics of each gum, vulcanized to the highest degree, are respectively 1·05 for the control coagulated with acetic acid and 0·91 for the control coagulated with fluosilicate of soda; the latter is therefore only worth 86·8 per cent. of the former. The coefficient characteristics, when the samples are old, are respectively: 0·66 when coagulated with acetic acid and 0·45 when coagulated with fluosilicate; the latter is only worth 67·6 per cent. of the former.

Tryparsamide Treatment of Neurosyphilis (Harry C. Solomon, M.D., and Henry R. Viets, M.D., *Journal of the American Medical Association*, August 1, 1925).—Serologic improvement has been marked in the majority of cases of all types of neurosyphilis treated with tryparsamide. In addition to the decrease in pleocytosis in the spinal fluid reported last year, reductions have been found in the Wassermann reaction, colloidal gold curve and globulin. Occasionally the spinal fluid has become normal after a few injections of tryparsamide, but in the majority of cases of parenchymatous neurosyphilis, fifty or more injections have been required to produce serologic improvement. Some cases, having received long courses of treatment with arsphenamin and other methods, without marked serologic improvement, have responded to tryparsamide. In general, in patients with neurosyphilis, more rapid and more marked clinical improvement has been observed under treatment with tryparsamide than with the older methods. Cases of early paresis have usually shown remission and have con-

tinued to hold their clinical improvement over the two-year period during which tryparsamide has been used. Clinical results have not yet been as good with the older cases of tabes with marked signs of degeneration of the spinal cord. Very few untoward symptoms, and none of marked importance have occurred in the last year. It has been found that it is often necessary to give tryparsamide over a period of a year or longer before either good serologic or clinical results can be expected.

Intarvin in Diabetes (Max Kahn, M.D., *Archives of Internal Medicine*, July 15, 1925).—The following results have been obtained through feeding intarvin to diabetic patients: It nourishes them so that they gain weight; it allays their sense of hunger. It strengthens them so that they do not feel so "weak and tired," the usual complaint of the diabetic patient. It never produces ketosis, i.e., beta-oxybutic acid, diacetic acid or acetone. It never produced acidosia. The latter has been determined in more than 100 cases by examination of the blood for the carbon dioxid combining power. It never yields glucose. Many more patients can be treated with intarvin and thus insulin can be preserved for the patients with very severe diabetes who really need it.

Abstracts.

HINTS ON TROPICAL TECHNIQUE.[1]

By ALEXANDER MARSHALL and NORMAN MACDONALD,
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In the tropics the difficulties of adhering to and following the general routine of laboratory technique must be experienced to be appreciated.

Methods as described in textbooks often prove quite unsuitable, and provide disappointing results when employed under tropical conditions. Modifications and improvisations are often necessary, as many adverse conditions present themselves. It is our aim in this series of notes to supply the laboratory worker in the tropics with some hints on laboratory technique, which we hope may be of practical value.

CLEANING GLASS APPARATUS, SLIDES AND COVER-GLASSES.

To clean laboratory glass-ware and render free from grease, place for one hour in a solution consisting of 100 grammes of caustic potash in 100 c.c. of water and 800 c.c. of methylated spirit, and afterwards rinse thoroughly in water. Cover-glasses should never be stored in a dry condition, but after cleaning should be kept in 60 per cent. alcohol. The cleaning solution can be used repeatedly.

[1] Abstract from the *Laboratory Journal*, December, 1924.

STERILIZATION OF SYRINGES BY BOILING.

It is important after sterilizing syringes by boiling to wash them out with a little sterile normal saline before taking blood. Very often a little water is left in the needle, and is liable to hæmolyse the blood.

TO STORE AND STERILIZE NEEDLES FOR BLOOD-LETTING.

A good way of sterilizing needles and keeping them ready for blood-letting for the Wassermann test, &c., is to obtain an ordinary glass xylol pot filled with absolute alcohol. Pass the needles, point downwards, through lengths of glass tubing, diameter about $\frac{3}{16}$ in., and a little longer than the needle. By placing the tubes with the needles suspended in them in an upright position in the pot of alcohol the points are preserved from injury. It is essential, before using a needle, to pass it through the flame and burn out the alcohol.

STORING AND STERILIZING GLASS CAPILLARY PIPETTES.

A very convenient way of storing and sterilizing capillary pipettes ready for use is to obtain a box made of zinc with square sides, dimensions 10 in. by 5 in. by 5 in., with a fairly tight-fitting lid.

Two square sheets of zinc, perforated with a number of holes of a size suitable for the pipette stems to pass through, and spaced so that the upper and wide ends of the pipettes can be comfortably arranged, are fixed inside the box one above the other. To accommodate pipettes 9 in. long, the lower plate should be fixed at a point 3 in. from the bottom of the box and the upper one about 2 in. from the top. The holes in the zinc plates should be directly opposite one another, so that the pipettes will stand in an upright position. The pipettes are then stored in the box with the capillary ends resting on the bottom and the whole sterilized by dry heat. To remove a pipette for use, place the box down on its side, thus eliminating the chances of aerial contamination.

TO STORE RUBBER TUBING.

As rubber tubing readily deteriorates in the tropics, store in glycerine (ordinary quality).

Another method is to store the tubing in bottles containing carbon dioxide gas. The tubing is coiled inside the bottles, which should be fitted with corks effectively sealed with melted paraffin wax, and having a central aperture sufficiently wide to allow the tubing to pass through. The gas is then passed through the tubing into the bottles, and the opening subsequently plugged with a piece of glass rod.

When a portion of tubing is required, withdraw what is wanted through the aperture in the cork, cut off and replace the glass plug in the open end of the tubing left protruding from the cork.

Hydrogen-ion Concentration Method of Standardizing Media.

The reaction of any fluid is determined by the relationship between the hydrogen- or hydroxyl-ions present in it, expressed symbolically as pH.

A neutral fluid is one in which the concentration of hydrogen-ions is the same as hydroxyl-ions, and at 21° C. is expressed as pH 7. If the pH is less than 7, the fluid is acid; if the pH be greater than 7, it is alkaline. For bacteriological purposes, a range between pH 7·4 and pH 7·6 is usually employed.

The solutions required are: I.—A one-fifth normal solution of dihydrogen potassium phosphate. This is made by weighing out 13·616 grm. of the salt and dissolving it in about 300 c.c. of boiled distilled water. The mixture is then made up to 500 c.c. with boiled distilled water. II.—A N/10 solution of sodium hydroxide.

From these two solutions the following mixtures are made up:—

N/5 KH_2PO_4	N/10 NaOH	Water to	pH
25	17·80	100	6·6
25	23·65	100	6·8
25	29·63	100	7·0
25	35·00	100	7·2
25	39·50	100	7·4
25	42·80	100	7·6
25	45·20	100	7·8
25	46·80	100	8·0

A grain of calomel is added to these solutions to prevent bacterial growth.

Cordite tubes (as supplied by Baird & Tatlock) are then filled with the above solutions, adding 10 c.c. to each tube and 0·4 c.c. to each tube of a 0·02 per cent. solution of phenol red. The tubes are then set out with the proper pH indicated upon them, and should be kept in the dark when not in use. It is advisable to fill the tubes once a month from the stock solutions, as the phenol red is liable to fade after that time. The 0·02 per cent. solution of phenol red is prepared by dissolving 0·1 grm. of phenol sulphonephthalein in about 100 c.c. of distilled water, to which 10 c.c. of N/10 sodium hydroxide solution have been added. About 300 c.c. of water are added, and the alkaline solution of the indicator is exactly neutralized with 10 c.c. of N/10 hydrochloric acid. The volume is then made up to 500 c.c.

Method.—10 c.c. of the medium is measured into one of the cordite tubes, and 0·4 c.c. of the 0·02 per cent. solution of phenol red is added. This tube is put in place 5 of the viewing rack. In places 4 and 6 are put the standard tubes of the reaction between which it is desired to adjust the medium. In place 2 is put a tube of distilled water. In places 1 and 3 are put tubes containing the medium without the addition of indicator.

In this way the light passing through the standard tubes 4 and 6 traverses tubes containing uncoloured medium 1 and 3, while the tube containing medium and indicator in 5 is backed by a column of water. The conditions under which the light comes through the columns of liquid in all three sets of tubes are thus identical.

With a 1-c.c. pipette graduated in 1/100ths, drop in N/10 NaOH to tube containing the medium until the tint comes between the tints on either side of the pH required. After the addition of each small quantity of N/10 alkali the contents of tube 5 are well mixed before comparison.

Knowing the amount of N/10 alkali which is necessary to bring the contents of tube 5 to the required tint, it is easy to calculate how much decinormal alkali will be necessary to bring a large volume of the medium to the requisite hydrogen-ion concentration.

To make a viewing box for the above method, obtain six square wooden test-tubes boxes suitable for carrying test-tubes 6 in. by 5/8th in. Pierce a round hole about 5/8th in. in diameter through the centre of the lower third of each. Place the boxes together so as to form one block with the view holes directly opposite one another. Bind the whole with black paper, leaving the view holes open. Number the boxes from left to right, 1 to 3 behind and 4, 5, 6 in front.

Culture Media.

In the preparation of media, all methods of sterilization must be carefully carried out, as the presence of moulds, aerial and dust organisms (many of them spore-bearing) are a frequent cause of contamination. In a tropical climate, moulds of a highly resistant type often grow on the under-surface of cotton plugs, and to obviate this, it has always been our practice to carry out a preliminary sterilization of the cotton in the hot air chamber for 1½ hours at 150° C. before using it for plugging tubes.

It is advisable to sterilize all media in the autoclave; one sterilization at 15 lb. pressure for a period of fifteen minutes is, we find, much more satisfactory and quicker than the three consecutive sterilizations in the steamer.

Filtration of Agar.

After autoclaving allow the flask of agar to stand for five minutes to permit the coagulated elements to settle, and filter through glass wool. It is unnecessary to heat the funnel, as filtration of the agar is so rapid that in ten minutes a litre of clear agar will be obtained. It is as well to mention here that we add 2 per cent. agar to our media, as a firmer consistency is required than that used in a temperate climate.

Carbohydrate Media.

In the preparation of carbohydrate media we carry out the following procedure: Make a litre of lemco meat extract broth in the ordinary way and render pH 7·6. After boiling, allow to stand until the phosphates have precipitated. Filter and adjust the pH.

Next add the required percentage of Andrade's NaOH fuchsin indicator and 1 per cent. of the sugar to be used. Tube and sterilize in the autoclave at 15 lb. pressure for ten minutes. This

heating is not always sufficient to drive the air completely out of the Durham's tubes; therefore, a preliminary heating in the steamer for five minutes at 100° C. is recommended.

We find the above to be a very satisfactory method, as it sterilizes the media completely and reduces to a minimum hydrolysis of the carbohydrates which is known to take place when overheated in the presence of peptone and other proteins.

C.R. Milk.

We prefer to add C.R. indicator to our milk instead of litmus as it stands autoclaving very well and remains unaffected by the climatic conditions.

Indicator.—Equal parts of a 1 per cent. watery solution of China blue and 0·5 per cent. solution of Rosolic acid in 95 per cent. alcohol.

To prepare C.R. Milk.—Steam fresh milk for fifteen minutes and place on ice-chest for eight hours, or better still, centrifugalize for fifteen minutes. Separate cream and dilute milk one-third of distilled water. This facilitates heat penetration during sterilization. The C.R. indicator is added in the proportion of 2·5 per cent. Boil milk for five minutes, tube and sterilize. If the medium appears too acid, the reaction is adjusted till a pale grey colour is obtained. Blue indicates acid and pink alkali.

Loeffler's Blood-serum.

In the preparation of this medium the intermittent method of sterilization is best avoided. Not only is it a slow process, but in the tropics, where blood-serum cannot always be procured in a sterile manner, the possibilities of the growth of aerial and dust organisms in between the periods of sterilization are great. To overcome this difficulty, we inspissate the tubes of media from eight to ten hours, raising the temperature gradually until it reaches the maximum of 70-75° C. If the inspissation cannot be carried out on the one day, the medium can be exposed to the maximum temperature for the remainder of the period on the day following. If this is done, it is advisable to place the tubes of media in the ice-chest overnight. The idea is to coagulate the serum slowly, and thoroughly, so that no soft parts will be left to bubble their way through the body of the medium and break up the surface of the slopes during sterilization. The tubes of media are finally sterilized in the autoclave at 15 lb. pressure for ten minutes. By this method the finished medium is highly satisfactory in every way, and equally as good as that prepared by the tedious intermittent method.

Sabouraud's Maltose or Glucose Agar for the Cultivation of Fungi.

We recommend the above medium as being most suitable for the cultivation of fungi. To prepare this medium, first of all make up the agar in the ordinary way, and after filtration add the percentage of sugar required, tube and sterilize in the autoclave at 15 lb. pressure for fifteen minutes. It is essential to add the sugar to the prepared agar, otherwise the prolonged heating of the two combined affects the solidifying properties of the agar. Preserve the water of condensation in the agar slopes as moisture is most necessary for the cultivation of fungi.

Horse-dung Agar.

This is a highly suitable medium for the cultivation of fungi. Dry horse-dung 200 grm., water 1,000 c.c., infuse for twenty-four hours. Filter through muslin, then through filter paper without neutralizin. Add to 500 c.c. of above: peptone 5 grm., agar 10 grm. Sterilize for twenty minutes at 120° C. Filter; add glucose 20 grm. Tube and sterilize for ten minutes at 115° C.

McConkey's Bile-Salt Lactose Agar.

For the isolation of intestinal bacteria such as organisms of the typhoid and dysentery groups by plate culture, we recommend the above medium. We have tried most of the other media recommended for this work, and find McConkey's agar the most reliable. It is easy to prepare, and stands the tropical heat exceptionally well. On adding the neutral red to this medium, we find it more expedient to add 0·05 grm. of the powder per litre direct, instead of the usual process of making up a 1 per cent. solution and adding from this 0·5 per cent. The neutral red powder is dissolved by stirring vigorously in a mortar containing about 200 c.c. of the hot medium. Our reason for doing this is because the neutral red does not keep for any length of time after being made up.

It is advisable to pick off any apparent non-lactose fermenting colonies that appear on the plate culture of the medium, and transfer to a tube of lactose broth, as late lactose fermenters often remain colourless for two to three days on the solid medium, but readily show fermentation in the fluid medium.

We recommend the following media for the growth of the more delicate bacteria: *Gonococcus*, Cole's blood-agar; *Streptococcus*, Holman's broth; *Meningococcus*, Buchanan's solidified blood-serum; *Pneumococcus*, whole blood-agar.

Blood Culture.

Three sterile broth flasks of a pH 7·6, and containing 100 c.c. of medium in each, plus a few glass beads, are used. Withdraw 7 c.c. of blood from a vein in the arm, and add 2 c.c. to each of the flasks. Rotate the flasks immediately after inoculation, so that the beads contained in the medium will defibrinate the blood. Incubate at 37° C. for forty-eight hours, then put up an agar slope from each.

Storing of Media.

In the hot seasons of the year, culture media are very apt to become desiccated owing to the evaporation of the water of condensation. This can be prevented to a great extent by storing the tubes of media in circular glass jars with zinc lids. A ring

of plasticine is inserted inside and round the periphery of the lid; the layer of plasticine must be sufficiently plentiful to allow the opening of the jar to be effectively sealed when the floor of the lid is pressed down. The advantage of the method is, that as each worker withdraws a tube from the jar, the lid can be easily and readily sealed again by simply pressing down the lid.

McConkey's Agar for Out-stations.

Occasionally requests are received from medical officers at out-stations for a supply of McConkey's bile-salt lactose agar plates. If the medium is to be forwarded by post, it is advisable to send it contained in flasks of 100 c.c. capacity, accompanied by sterile Petri dishes wrapped up in filter paper. Instructions to pour the medium into the plates, taking the usual aseptic precautions, should also be enclosed.

Sending Fluid Media in Flasks by Post.

To obviate the risks of contamination of fluid medium forwarded by post we find it expedient to seal the flasks with surgical oiled silk instead of the usual cotton-wool plugs. The oiled silk should be sufficiently large to be turned down and fastened by a few turns of thread round the neck of the flask and under the lip. The flasks of media are then sterilized in the autoclave at 15 lb. pressure for twenty minutes. On cooling, the silk covering is pulled taut by the contraction of the fluid and air within. The silk is then smeared over with melted paraffin wax, and a perfectly air-tight covering is obtained. To inoculate the flask, heat the surface with a hot sterile knife or other suitable implement; pierce the covering with a syringe needle, and squirt the syringe contents into the medium. Withdraw the syringe needle and close the puncture by melting the paraffin again with the hot sterile instrument.

The method described is much more serviceable and permanent than the use of rubber caps or corks, and certainly more economical.

Despatching Blood Films by Post.

Pack the films together with intervening bits of cardboard to prevent the slides from rubbing. Roll them up in good strong white paper. Seal the ends of the packet with sealing wax; then drop into a vessel containing melted paraffin. Leave in the paraffin just long enough for the packet to become permeated with the wax. This method will preserve the smears for an indefinite period and prevents the growth of fungi, which are so troublesome to workers in the tropics.

The Keeping of Stock Cultures.

Rubber caps being out of the question in the tropics owing to their perishable nature, a clean and economical way of sealing stock cultures is by the use of thin, white paper and melted paraffin; thin typing paper is the most suitable. A square of paper slightly larger than the diameter of the culture tube is cut, and a layer of melted paraffin spread over it with a small brush. Next flame the outside of the cotton plug and push it slightly below the level of the top of the tube. Warm the top of the tube a little, and placing the paraffined paper over the opening, apply gentle pressure with the palm of the hand until the paraffin sets. Next take a glass slide and scrape away the surplus paper round the tube opening. It is as well to paint over the outside of the paper covering again so as to strengthen the surface. Should the tube be required for subculturing, it is a simple matter to flick away the paper with the point of a pair of forceps.

Collection of Stools for Microscopical Examination.

A suitable improvised means of sending stools to the laboratory for examination is to obtain the tin covering of crown head corks from soda water bottles. Remove the disc of cork and punch two small holes in the rim about $\frac{1}{4}$ in. apart. Pass an ordinary hair-pin of stout quality through the holes from without inwards, bend the loop end over and inwards to form a grip. Next bend the prongs of the hair-pin upwards and backwards until they are at right angles with the crown head cover. Finally press the turned-over loop and prongs of the hair-pin firmly against the rim of the metal cover with a pair of pliers, and a firm grip will result. The scoop is best contained in a glass sample tube $2\frac{1}{4}$ in. by $1\frac{1}{2}$ in., and is fixed by simply pushing the hair-pin ends into the lower part of the cork.

Picric Acid as a Fixing Reagent.

A saturated watery solution of picric acid (1 part in about 86 parts of water dissolved at 15° C.) has been used by us for many years as a fixing reagent for skin and dense fibrous tissues. It has the advantage that no excessive hardening takes place as the result of the fixation, which is effected in from one to several hours, according to the nature and size of the piece of tissue. After fixing, the tissue is washed in running water for several hours and carried through to paraffin in the usual manner. Although it has been stated that the gradual weakening of the picric acid by water, even when used in the composition of the stains, tends to disintegrate the tissues, we have failed to notice any disintegration even after washing the tissue in running water for twelve hours and using watery stains on the sections.

Museum Jars.

Owing to the intense heat during the summer months in the tropics, great difficulty was experienced with regard to museum specimens. Not only the lids would crack, but even the jars themselves. Various cements were used in the sealing of the lids to try and overcome this difficulty, but without success. Finally, we resolved to allow for expansion and contraction by drilling a very small hole in the lids of the jars. In some cases we sealed the hole thus made with a thin cover-glass and

Canada balsam; in others, the hole was left open and no appreciable evaporation of the fluid was noticed. The method seems to be a solution of the difficulty, as the jars and lids, without exception, have withstood the rigours of a tropical summer.

Vaccine Caps.

The rubber caps of bottles containing vaccine are best coated with a wax of low melting point, as we find that the ordinary paraffin used for section cutting (m.p. 56°-60° C.) cracks and flakes off, leaving the rubber exposed.

Widal's Agglutination Test.

Garrow's agglutinometer is an ideal instrument for the above test, and no worker in the tropics should be without one.

Cooling of Water and Solutions for Photography.

Photography in the tropics, in a close, hot, dark room, is a trying experience, and even although one starts off with ice-cooled solutions, they very soon become warm. If a good table electric fan is available, there is no necessity for using ice at all. A better way is to set the dishes containing the solutions in a line in front of the electric fan. Let the fan play on the dishes, and in about ten minutes the solutions will become quite cold and will remain at a suitable temperature for any photographic plate or film, and, moreover, the photographer enjoys its cooling properties on his heated brow.

Ice-Chests.

All ice-chests with doors opening in the side and where the ice is contained in a jacket round the chamber require a great quantity of ice to keep them really cold, and every time the door is opened the temperature of the chamber is raised considerably. A cheap and economical ice-chest may be made by using two large square wooden boxes, the inner one lined with zinc and of suitable size to leave a space of about four inches all round between it and the outer box. This space is tightly packed with sawdust, old blankets, charcoal, or cotton. The lid opening on the top is also packed, lined with zinc, and should be fairly tight-fitting. An ice container is made by cutting in half an ordinary kerosene or petrol tin and of suitable size to go inside the inner box. This tin is easily removed and the water emptied when fresh ice is put in.

Current Literature.

Bulletin de la Societe de Pathologie Exotique. July 8, 1925.

Eparseno or Dr. Pomaret's "132" in the Treatment of Leprosy (F. van den Branden).—This arsenical has already been used in the treatment of leprosy by Chartres and Hasson with very good results. Hasson used massive doses by intramuscular injections daily, but the author found in following this method that phenomena of intolerance were shown by the patients, such as loss of weight, general malaise, neurotic pains, inappetence, &c. The product causes clinical ameliorations; cicatrization of the ulcers, change in colour of the muscular lesions, but they are only of short duration; new cutaneous lesions have been observed in a leper after long treatment with eparseno.

Culture of Entamœba dysenteriæ by the Method of Boeck and Jaroslav (F. H. Guerin and R. Pons).—*Entamœba dysenteriæ* was cultivated by Boeck and Drbohlav (1924) at Boston, U.S.A., on a medium of coagulated egg and Ringer's solution albuminized. These observations confirm the results obtained at Boston, and also give definite points on the technique of the cultures. It is proved that dysenteric amœbæ can be cultivated in the presence of only one microbic germ by experimental selection, as was discovered by Gauducheau for *Endolimax phagocytoides* (1908).

Batrachia which Harbour and Propagate certain Intestinal Flagella of Man (E. Escomel).—On examining batrachia taken from rivers and drinking water sources of Arequipa the intestinal tract was found to contain numerous protozoa. When the animals are taken out of the water, and the water is centrifuged, large numbers of *Trichomonas batrachorum*, *Opalina ranarum*, *Nyctoterus*, *Monadina*, *Amœbæ* and other protozoa are found. These protozoa multiply in the intestine of the batrachia in very large quantities, and are expelled alive into the water and damp earth. Experiments show that the protozoa soon die if deprived of nourishment. It is therefore most necessary that all drinking waters should be cleared of these animals, and also of seaweed, which serves as nourishment to the protozoa.

Presence of Rhabditis Larvæ of Strongyloides stercoralis (Bavay, 1877) in Duodenal Liquid taken by Tugaba. Clinical Notes on Anguilluliasis (R. Deschiens and O. Taillandier).—Rhabditoid larvæ were found in the duodenal liquid taken from a patient of Haiti presenting *Strongyloides stercoralis* in the stools. The larvæ were 200-300 microns in length and 14-17 in width. The patient had been infested for seventeen years; he had attacks of diarrhœa, digestive troubles with duodenal ulcer syndrome, and was neurasthenic. The duodenal lesions of anguilluliasis and the possible duodenal ulcer syndrome were detected by X-rays.

Notes on an Epidemic of Bacillary Dysentery in Mayombe (Belgian Congo) (L. Van Hoof).—Bacillary dysentery occurs sporadically all over the Congo, but in places where hygienic conditions are not satisfactory it takes on an epidemic form with sometimes a very high mortality. The malady in its epidemic form has been observed at Mayombe during the past few years among the different tribes. Famine is the first and foremost of the causes of the disease, which very often takes place during the months of September and October. Transport

by caravans, &c., is another means of transmitting the disease. Helminthiasis and intestinal amœbiasis frequently coexist with bacillary dysentery, thus rendering diagnosis and treatment difficult.

Parasitism and Morbid Reactions in Chronic Malaria in Native Children of Algeria (H. Foley, A. Catanei, M. Brouard and P. Demimuid).—In the Tell region, amongst the Arabs, the splenic index is always higher than the plasmodic index. The three species of plasmodium are found, alone or, rarely, associated. The chief vector of malaria is *Anopheles maculipennis*. At Beni Ounif-de-Figiug, and in all the cases of northern Sahara, where the population is mixed, the splenic index is always very inferior to the plasmodic index. The seasonal plasmodic index is much less than the annual index, which accounts for the frequent absence of *Plasmodium*. The infection is frequently found in children of all ages up to ten years, it gradually decreases up to fifteen years, and after that age is very rare. In certain adults, white race, *Plasmodium* are found in the blood, although all clinical symptoms are absent. The association of *P. vivax* and *P. præcox* is very frequent.

Anopheles multicolor is the vector of malaria in all the Algerian Sahara.

The Action of Stovarsol in Chronic Malaria due to Plasmodium vivax in Native Children in Algeria (H. Foley, A. Catanei, M. Brouard and L. Leblanc).—Stovarsol administered *per os* has given very good results in the treatment of chronic malaria; it causes no reactions and is well tolerated even in large doses. In two to three days it causes the disappearance of all *Plasmodium vivax* from the peripheric blood.

Notes on Malaria at Tangiers during the Last Twenty Years (H. Charrier).—The statistics of the French Hospital at Tangiers show that malaria has been on the increase during the past twenty years; this is probably due to the extension of the town towards the sites of *Anopheles*. As regards nationality, the Arabs furnish most cases of malaria; this, no doubt, is due to their occupations, while there are very few cases among the Jews. Among Europeans malarial cases are to be found chiefly in the Spanish people. The climate at Tangiers is most favourable to the evolution of the hæmatozoa of mosquitoes during six months of the year, i.e., May to October; the rains, winds and humidity also have an influence on the life-history of mosquitoes and on their power to transmit infection.

Human Intestinal Coccidiosis due to Isospora belli (*Wenyon* 1922). *General Observations. Study of Two New Cases observed at Saigon* (R. Pons).—A very interesting account is given of the history, geographical distribution and morphological characters of intestinal coccidia. An accurate diagnosis can only be made by microscopical examination; the stools will be found to be rich in oöcysts of coccidia; attention is drawn by the presence of the sporoblast, spherical, granulous mass, and the enveloping membrane.

Communication on the Nature of the Epidemic of Glossitis observed in Senegal (C. Mathis and Guillet).—This epidemic of glossitis broke out among the school children of Dakar during the months of February to April, 1925. There were six principal types observed, but the bacterium to which the disease was due has not yet been completely identified. As the epidemic is seasonal in Senegal, there may be further possibilities of carrying out researches.

Notices.

BUSINESS AND GENERAL.

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Original Communications.

PHOSPHORUS IN THE TREATMENT OF VARIOUS DISEASES.

By ALDO CASTELLANI, C.M.G., M.D., F.R.C.P.

Director of Tropical Medicine, Ross Institute and Hospital, London; Lecturer London School of Tropical Medicine.

PHOSPHORUS at one time was considered to be of great benefit in various diseases, especially diseases of the nervous system (paralysis agitans, locomotor ataxy, impotency of various origin); it was also used in the treatment of leukæmia, pseudo-leukæmia, chronic tuberculosis and osteomalacia. Later its use was practically abandoned, this being caused, to a great extent, by difficulty in finding a stable preparation to be given by the mouth.

For some years I have been interested in phosphorus as a therapeutic agent since I found that the drug in the form of Oleum Phosphoratum of the British Pharmacopœia can be given subcutaneously by hypodermic injection, causing very little or no discomfort. In this paper I will briefly recapitulate my results with phosphorus in various diseases.

Preparation of Phosphorus Used.—The preparation I have used, both for external and subcutaneous use, is the phosphorus oil of the B.P. Messrs. Martindale and Co., at my suggestion, supply it now in very convenient ampoules of two kinds; ampoules containing 5 minims of pure phosphorus oil, and ampoules containing ½ minim diluted in 10 minims of almond oil.

Oriental Sore (Cutaneous Leishmaniasis).

I have published several papers on the treatment of oriental sore with phosphorus, which I introduced in 1923. The results seem to be in most cases satisfactory; the best results are obtained in old intractable cases in which the ulcerative process is extensive. The technique of the treatment is as follows: when the ulcerative process is well marked, the oil is simply dabbed on the fundus and margin of the sore, after removing the scab, every other day. When the ulcerative process is not well developed, and the lesion is nodular, in addition to the external use of the oil 3 to 5 minims of it are injected by means of an all-glass hypodermic syringe under the skin around the nodule, and at times also into the nodule, once or twice a week, according to the reaction caused. The actual injection is practically painless. As a rule there is no general reaction; the local reaction is often slight, but occasionally signs of acute inflammation develop; in such cases the treatment is discontinued for a time and hot boric fomentations are applied.

Granuloma Inguinale.

Recently I have had two cases of granuloma inguinale in which the tartar emetic treatment induced only a slight improvement. One of the patients, a South American, had contracted the disease in Central America. The lesions, situated in the left inguinal region, though not of great extension, were typical, and scrapings contained Donovan bodies in abundance. Wassermann was negative. The ulcerations were thoroughly cleansed with boric fomentations for two days, and then the phosphorus treatment was started. This consisted in the simple application all over the ulcer of phosphorus oil every other day. Within six weeks the ulceration healed completely. In the second case, a half-caste who contracted the disease in the West Indies, and who had ulcerative lesions in both inguinal regions, the phosphorus treatment had no beneficial action.

Tropical Sore.

In a case of very chronic tropical sore of the leg, in a Ceylon planter, the phosphorus oil did not induce any improvement.

Psoriasis and Lichen.

I have tried phosphorus in several cases of psoriasis and lichen planus with no beneficial results.

Malaria.

Phosphorus alone has no effect on the malaria parasites; in certain very chronic cases of the disease it seems, however, to act as a good adjuvant of quinine. It is given subcutaneously in very small doses, half minim to three minims of the phosphorus oil twice a week.

Other Diseases.

Some years ago I used phosphorus oil in several cases of rickets and in two cases of osteomalacia with encouraging results. I have also used it in cases of tropical neurasthenia and impotency with, however, no very brilliant results.

In a case of beri-beri a distinct improvement took place.

Conclusions.

Phosphorus seems to be useful in various diseases. The preparation of phosphorus I have used is the phosphorated oil, B.P., which some years ago I found could be given by hypodermic injection with very little or no discomfort to the patient. In certain cases of oriental sore it acts practically as a specific. Of two cases of granuloma inguinale one responded to the phosphorus treatment, the other did not. It seems to be useful as an adjuvant of quinine in certain cases of chronic malaria, and its action also seems to be beneficial in osteomalacia and rickets.

Phosphorus is a powerful drug and its delayed action on the liver should especially be kept in mind; it should therefore be given with care and every precaution should be taken. I may say, however, that so far in my hands its use has never been followed by any untoward effect.

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A NOTE ON THE TREATMENT OF AMŒBIC DYSENTERY WITH STOVARSOL.

By F. M. Johns, M.D.,

AND

S. Chaille Jamison, M.D.

From the Department of Medicine, Tulane University School of Medicine, New Orleans.

Dr. E. Marchoux reported in the official *French Bulletin of the Société Pathologie Exotique* [1], February, 14, 1923, the eradication of *Entamœba dysenteriæ* cysts which had persisted in a patient following the clinical cure of his dysentery with emetine, by the use of stovarsol (oxyaminophenylarsenic acid). Doses of 0·25 grm. were administered by mouth twice daily until twenty successive doses were given. Three cases of *E. coli* infection were similarly sterilized. Remarkable clinical results were also reported in chronic amœbic dysentery, but these were followed by relapse in from ten days to three weeks.

This publication by Marchoux was soon followed by one by Nogue and Leger [2], who reported three cases treated, one of whom relapsed nine days later and had to be treated with emetine.

Delanoë [3] reported the rapid clinical cure of two cases, one of which was of four years' duration. Subsequent observation was not reported.

At the Conference on Tropical Health Problems held in Kingston, Jamaica, in July, 1924, Drs. Ch. Garin and P. R. Lepine [4] reported the use of stovarsol followed by hypodermic administration of emetine or of acetylarsan, in a series of forty cases of amœbiasis. No detailed studies of the effect of stovarsol alone were given and the number of ultimate cures was not tabulated; neither was the length of time stated that patients had been observed.

Dr. Lepine kindly furnished one of us (Johns) with enough stovarsol (through the courtesy of the manufacturers, Poulenc Frères, Paris) to treat several cases of dysentery. A larger quantity of the drug has been furnished for experimental purposes by Messrs. Powers, Weightman and Rosengarten, of Philadelphia.

Up to the present time we have treated twenty-seven cases of amœbic dysentery with stovarsol. The results have been so remarkable that we feel justified in making this preliminary report. The cases have ranged in severity from chronic dysentery of long duration to active, severe, emaciated clinical cases. The duration of the disease has ranged from a few weeks to as long as twenty-five years. Diagnosis was confirmed in all cases by the presence of endamœbæ in the stools or in scrapings obtained through the proctoscope and was always verified by the use of wet fixed preparations stained by the iron-alum-hæmatoxylin method of staining the nuclear structure.

In all instances (except one patient that received a smaller amount) stovarsol in 0·25 grm. doses administered three times daily for one week caused complete subsidence of their symptoms, the improvement usually beginning about the third or fourth day of treatment.

The first case treated was found to have developed encysted entamœbæ on the fifteenth day following stovarsol treatment, in spite of the hypodermic administration of emetine during the interval. The fourth case presented a clinical relapse on the sixteenth day, vegetative entamœbæ being found in the semi-liquid stool.

Three cases remained well and free from entamœbæ up to the present time upon the one course of treatment. Two of these received seven ½-gr. doses of emetine, which was hardly sufficient to account for a cure by itself. These patients have been under observation for ninety-nine, seventy-four and seventy days, respectively.

The remaining cases have received a second course of stovarsol seven to ten days after the first and consisting of three 0·25 grm. tablets per day for seven days, or two tablets for twelve or fourteen days.

Up to the present time (January 20, 1925) we have been able to follow with clinical, proctoscopic and microscopic examination twenty cases for an average period of fifty-five days following completion of their treatment. Sixteen cases have remained well and free from entamœbæ for the period of observation.

Four cases have relapsed; three of these clinically, and one developing cysts. The clinical relapses occurred within two weeks and were noted in patients having had dysentery for three to five years almost continuously. It must be noted, however, that the lesions as found by proctoscopic examination had subsided to a remarkable degree, a single rectal granulation the size of a silver dollar in one instance and pin-point ulcerations in the other.

Many of the apparently cured patients have been proctoscoped, and stool examinations were repeatedly made, all with negative findings. It has been our experience that vegetative entamœbæ can be demonstrated by proctoscopic examination of the rectum or cysts can be found in the formed stools within twelve to fifteen days following completion of a course of treatment of whatever kind in practically all cases that subsequently relapse. This experience leads to the hope that these cases treated with stovarsol, and which are still free from symptoms or entamœbæ, may be permanently cured of their infection.

Long standing cases with massive involvement of the bowel walls present the same difficulty of treatment that applies in other tissue-invading parasitic diseases, the parasites being protected by impermeable walls of exudate and tissue proliferation. Indeed, it is evident that no known specific will cure in all instances. It is hoped, with the establishment of definite knowledge regarding the tolerance for this drug when given over longer periods of time than we have dared employ it, that the results will be even better than are here indicated.

Stovarsol (acetyloxyaminophenylarsenic acid, or "190") is an arsenical designed by Levaditi and Navarro, to be administered through the digestive tract. It was synthetized by Fournier, Guenot and

Schwartz [5] and has been the subject of considerable European investigation in the treatment of syphilis. It is apparently partly absorbed from the small intestine and then excreted through the large intestine. It is relatively non-toxic. The only untoward effect attributed to it that we have found was a dull headache in one instance, mild rash in another and probably a rash with slight temperature in a third case.

We have not attempted to determine the proper dosage of stovarsol, but the following observations may be mentioned:

Quarter gramme per day in one case failed to influence the symptoms to any great extent in seven days.

Half gramme per day has given favourable results in two subacute cases.

Three-quarter gramme per day for seven-day periods has shown the most uniform results in the first course.

It will be necessary to follow these and other cases for a considerably longer period of time before we will know whether the apparent cures are complete or whether they are temporary. It is our intention to report more fully on these and other cases treated subsequently after a sufficient number have been under observation a sufficient length of time to determine the permanency of the results.

In the meantime, our experience so far indicates that we have in stovarsol a supposedly harmless remedy for amœbic dysentery that compares quite favourably with anything previously employed.

We desire to express our thanks to the following doctors for their assistance in referring cases and in the observation of this work: Drs. E. D. Martin, J. B. Elliott, H. E. Nelson, J. E. Landry, M. Bradburn, E. Bass, J. C. Cole, P. J. Kahle, J. Lescale, G. S. Bel, J. H. Smith, A. L. Levine, L. J. Stookey, A. M. Parson, and F. Loria.

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[1] Marchoux, E., *Bull. Soc. Path. Exot.*, 1923, February 14, xvi, No. 2, pp. 70-81.

[2] Nogue and Leger, *Bull. Soc. Path. Exot.*, 1923, xvi, No. 7, p. 557.

[3] Delanoë, P., *Maroc-Médical*, 1923, May 15, No. 17, p. 150, and *Bull. Soc. Path. Exot.*, 1924, February 13, xvii, No. 2, pp. 119-122.

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REPORT ON A FATAL CASE OF BACILLARY DYSENTERY IN NIGERIA.

By Andrew Connal, M.D., D.P.H., D.T.M.&H.,

AND

E. C. Smith, M.D., D.P.H.

From the Medical Research Institute, Lagos.

This report gives the clinical history, along with the bacteriological and post-mortem findings, in the first case of bacillary dysentery recorded from Nigeria.

Although the usual routine examination of dysenteric stools has been a regular procedure at the Medical Research Institute since its establishment, it was not until 1918, with the return of native troops and carriers from the East African campaign that it was decided to investigate fully and systematically all cases of dysentery occurring in Lagos. Special efforts were then made to secure freshly-passed stools from all patients.

Previous to the present case, the search was successful on only one occasion. In this instance, during 1920, a bacillus of the Flexner type was isolated from a case of amœbic dysentery, which occurred in a war veteran who had served in several countries where bacillary dysentery existed. There were, however, abundant *Entamœba histolytica* in the stools, the attack responded quickly to emetine treatment, and it was concluded that the patient was probably merely a carrier of the bacillus. Apart from this case, the search, continued practically uninterruptedly and by several workers during the past seven years, has been unsuccessful.

So far as can be ascertained, no bacteriologically confirmed case has been reported from the Gold Coast or from the Gambia. Sierra Leone, however, furnished a number of cases in 1919, as recorded by Butler [1].

A study of the annual medical and sanitary reports from the four West African colonies under British administration, shows that in some instances the dysenteries are classified as "amœbic," "bacillary," and "type undetermined." The diagnosis of "bacillary" is a clinical one. In general, it may be said that the mortality is not such as to indicate a bacillary form of the disease and there are no histories of epidemics. While it cannot be stated that bacillary dysentery does not exist, it may be asserted that the infection is uncommon. Nevertheless, so far as one can judge, the conditions, climatic and otherwise, are not unfavourable to endemicity, and it is for this reason that continued investigation is required.

It should be added that, in certain parts of Nigeria, schistosomiasis causes dysenteric signs and symptoms.

Present Case.

The patient, a male adult, native of Lagos, was admitted to the African Hospital under the care of Dr. C. J. H. Sharp, M.C., by whose kindness the investigation was assisted. On admission on August 5, 1925, the patient complained of dysenteric symptoms which had begun five days previously. He was put upon emetine and an examination of the fæces was made. The stool consisted of liquid bile-stained fæcal matter, showing flecks of bloody mucus. Under the microscope no amœbæ, cysts or spined ova were seen.

A loopful of the blood-stained mucus was mixed in 10 c.c. of peptone and after two hours this was inoculated on MacConkey plates. After twenty-four hours' incubation, colonies of a non-lactose-fermenting organism were obtained.

The organism was Gram-negative, non-motile and fermented mannite and glucose without gas-formation. It did not produce indol in broth cul-

ture. The patient's serum gave a rapid naked-eye slide agglutination with a known Flexner type of organism. Agglutination with a known Shiga and a known Y type also took place, but was much slower and less marked.

The patient rapidly became worse and died two days after admission.

Post-mortem Findings.—The post-mortem was made four hours after death.

Macroscopic.—The body showed marked general wasting and retraction of the abdominal wall.

Abdomen.—No fluid exudate was observed in the peritoneal cavity, but patches of fibrinous material were present here and there on the surface of the intestines and liver. The spleen was greatly enlarged and exhibited marked capsular thickening. The organ was very firm in consistence. The liver was darker in colour than normal and the lobulation was hard to distinguish in cut surface.

The kidneys presented a striking appearance—that of a typical blood-infection. These organs were very congested and were diffusely sown with small abscesses, each about the size of a pin-head, but varying in places owing to fusion. On removal of the capsule, many of these were broken into. Smears made from the contents revealed the presence of numerous polymorph cells and Gram-negative bacilli. No distension of the renal calyces or ureters was present.

The bladder contained a quantity of cloudy urine and the wall of the organ was covered with a fibrino-purulent exudate.

The stomach showed nothing of interest. In the small intestine inflamed hæmorrhagic patches occurred towards the lower end of the ileum. The colon, from the cæcum downwards, presented here and there irregular ulcerated areas intermingled with patches of hæmorrhage. The ulcerated areas were definitely patchy and not very extensive. A general enlargement of the mesenteric glands was found. They were soft and œdematous.

Thorax.—No pleural effusion was present. The lungs were congested and delicate fibrous adhesions occurred on both sides. The heart-muscle was flabby, but no valve-lesion was found.

Broth cultures were made from the heart's blood, the gall-bladder contents, the urine and the contents of the colon. A pure culture of a non-lactose-fermenter was obtained from the urine, the gall-bladder and the colon. This organism possessed similar properties to that obtained ante mortem from the stool.

Pathological Histology.

Intestinal Tract.—The lower portion of the ileum showed considerable vascular congestion with exudation, mainly of polymorphs, but also of round and plasma cells into the mucous membrane. In the colon a similar condition was present in a more marked degree, the mucous membrane in places being entirely replaced by the inflammatory exudate. Patches of a fibrino-purulent membrane occurred on the surface of the inflamed mucosa. In this membrane the polymorph cells predominated, but lymphocytes, plasma cells and red blood cells also took part in its formation. The submucous coat showed marked œdema and diffuse inflammatory infiltration. Small groups of inflammatory cells were also to be seen between the separated muscle bundles of the circular and longitudinal coats.

Mesenteric Glands.—The vessels in the capsules of these glands were congested and surrounded by halos of exudated cells. The gland tissue showed considerable distortion. Many clear areas containing an œdematous-like fluid or fibrinous exudate existed. In these areas, numerous Gram-negative bacilli were found, and these bacilli also occurred in small numbers all through the gland tissue. Plasma cells (pyronin-methyl-green stain) were very numerous, and in places almost completely replaced the normal lymphocytic tissue. Many of these cells were in a state of division. Large endothelial-like cells were also noticed.

Spleen.—This organ showed evidences of a pre-existent chronic condition. The capsule and trabeculæ were fibrosed and the sinuses greatly dilated. That the organ was involved in the present condition, too, was shown by the congestion of the vessels and the diffuse hæmorrhages into the pulp. Plasma cells were present in the Malpighian bodies and in these latter a Gram-negative bacillus could be demonstrated.

Liver.—The normal lobular formation was discernible and the cells appeared to be well preserved, but were separated to a considerable extent by congestion of the capillary vessels accompanied by an inflammatory infiltration. In the region of Glisson's capsule this infiltration was much more marked, especially around the bile-ducts. Here and there a miliary tubercle was present in the hepatic tissue. Gram-negative bacilli were demonstrated in the spaces between the liver-cells and in the biliary passages. They were present in dense masses.

Kidney.—Owing to the inflammatory infiltration (mainly polymorphic) which was present in this organ, nodular in some places, but in others occurring as diffuse areas, it was difficult to make out the normal structure. Many of the tubules were found to be lying in a bed of polymorph cells. In the lumen of the intact tubules pus-cells were present. The glomeruli were congested and to a certain extent disintegrated. Large numbers of Gram-negative bacilli were found in the abscess areas, some of the tubules containing what may be termed "bacillary casts." The congested glomerular capillaries also contained Gram-negative bacilli.

Urinary Bladder.—The lining epithelium was lacking in many parts, being replaced by a fibrino-purulent exudate containing large numbers of Gram-negative bacilli.

The thoracic organs, beyond showing congestion of the lung capillaries, were not noteworthy.

The case presents several interesting features. It serves to demonstrate that all cases of clinical dysentery in Nigeria need not necessarily be amœbic in type. Especially are those cases to be viewed with suspicion which have blood or pus and

blood in the fæces and in which no *E. histolytica* can be found.

The recovery of the bacilli from the fluid in the gall-bladder leads to a suspicion that this organ may, as in typhoid, harbour the organism for a considerable time (bile carriers). The condition of the kidneys and other organs examined points, without doubt, to a generalized blood infection of a severe nature, with relatively mild local involvement (i.e., of the colon), a condition not commonly met with.

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Colon Bacillus Infections (A. Basil Rooke, F.R.C.S., *The Practitioner*, September, 1925).—The author is of the opinion that colon bacillus is extremely prevalent and is the cause of a great deal of chronic ill-health. The stage of invasion is usually ushered in by an acute febrile illness, but it may be insidious in its onset. The condition tends to become chronic. Relapses or reinfections are the rule rather than the exception. The majority of cases are associated with colitis. Gross lesions such as appendicitis, cholecystitis and renal infections are extremely common. Toxic manifestations, such as irregular heart action, mental depression and derangement of thyroid, frequently occur. Treatment: This must be directed towards improving the condition of the intestine, increasing the patient's resistance. In order to prevent the disease from becoming chronic, treatment must continue for a long period after all signs and symptoms have cleared. It is as necessary for the *B. coli* infected patient to have the urine examined from time to time as it is for the syphilitic to have repeated Wassermann tests.

The Vernes Flocculation Test for Syphilis (Adelaide B. Baylis, Adele E. Sheplar, M.D., and Ward J. MacNeal, M.D., *Archives of Dermatology and Syphilology*, August, 1925).—The author is of the opinion that the Vernes flocculation test should be regularly employed in conjunction with the Wassermann test as a help in diagnosis and treatment of syphilis. The result of a single Vernes test is only suggestive unless the reading is high, 0·2 or above. Repeated tests at definite intervals giving essentially the same reading in spite of provocative treatment speak against a diagnosis of syphilis, even though the reading itself be high. On the other hand, a relatively low reading which changes appreciably on repeated tests speaks for a positive diagnosis. Conflicts between the results of the Wassermann and of the Vernes test are especially valuable, as at once a more complete view of all the evidence and the serologic examination of additional specimens are demanded.

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COMPARATIVE ANIMAL AND PLANT PATHOLOGY—EPIDEMIC PLANT DISEASES.

FOR many years the importance of the comparative investigation of diseases of man and the lower animals was completely ignored. Recently, however, the

subject has attracted attention, so much so, that a Section of Comparative Medicine was established three years ago by the Council of the Royal Society of Medicine. This Section is open to both medical men and veterinary surgeons, and the result has been most satisfactory from a scientific and practical point of view.

Though the time for such change is perhaps not yet ripe, it is the belief of the writer of this article that it would be of great scientific advantage to go a step further and include in comparative pathology the diseases of plants. Recent researches have shown that certain flagellates of plants may experimentally cause disease in animals, and it is probable that certain fungi pathogenic to man may live a saprophytic or parasitic life on plants. It is most interesting to see how certain epidemics of plants behave in exactly the same manner as epidemics of man and animals. With regard to this we quote a large portion of an exceedingly interesting article published by F. T. Brooks in *Trans. of British Mycological Society*, p. 299 (August 1924):—

All of us are familiar with disease in an epidemic form as regards illness to which human beings are liable. The widespread occurrence of influenza a few years ago need only be recalled to indicate the chief characters of an epidemic.

At that time many people simultaneously became ill with influenza, which spread with great rapidity from person to person. Thus the principal features of an epidemic are the large numbers of individuals in a population affected by the disease at one and the same time, and the amazing speed with which the malady spreads from the centres where it first occurs.

Plants of economic importance, in which large numbers of individuals of the same kind are usually densely aggregated, are also liable to diseases of an epidemic nature. As in human diseases, plant maladies are frequently caused by parasitic organisms, and epidemic diseases are almost invariably of a parasitic nature.

Not all diseases of plants are of an epidemic nature. Some are sporadic, i.e., occur only here and there and not universally over a wide area. Through neglect, however, a disease which is usually sporadic may assume an epidemic character. Thus silverleaf disease of fruit trees is usually sporadic in a plum plantation upon first appearance, but if neglected so that the causative fungus, *Stereum purpureum*, fructifies upon the dead branches, the disease may become so prevalent as to be an epidemic.

Epidemic diseases are essentially dependent upon two sets of factors for their development, namely, a condition of the host favourable to invasion by the parasite, and an environment of such a kind as to allow of the rapid dissemination of the spores and germination of these upon the surface of the host; these two sets of factors are intimately related to each other, for conditions detrimental to the growth of the host are often favourable to the development of the parasite. As regards the host being in a state of susceptibility to attack, it is a commonplace that individuals, whether of animal or of plant populations, vary greatly in their liability to certain diseases. It is also well known that even the most robust individual may become so weakened as to become susceptible to diseases from which normally he is free. Plants of economic importance, most of which have been in cultivation for long ages, exist in the form of numerous varieties which show marked differences in their susceptibility to disease. Some varieties of wheat are markedly resistant to yellow rust caused by *Puccinia glumarum*, while others are very susceptible; again in potatoes, some forms are badly attacked by the blight fungus and others are scarcely troubled by it. But often even the healthiest forms of cultivated plants may have their vitality so weakened under some conditions as to become a prey to a parasite which usually cannot thrive on it.

Granted, however, that the host plant is in a susceptible condition for attacks, epidemic disease will not follow unless the germs of the parasite are available in abundance and unless environment conditions favour their rapid dissemination and germination upon the tissues of the host. In fact it is not too much to say that weather conditions are usually all important in determining whether the disease appears in an epidemic form or not. This accounts for differences in incidence of such plant diseases in successive years. The prevalence of one of the commonest epidemic diseases, potato blight, is chiefly determined by weather conditions. In a wet summer great damage may be done by the vigorous spread of this fungus, and so rapid is the onslaught of the parasite under suitable weather conditions that potato fields sometimes become black in a day or two. In a moderately dry summer potato blight, though usually present to a slight extent, is of negligible importance. Under these conditions the spores of the fungus are produced in much smaller numbers, and the majority of them, even if they alight on potato leaves, are unable to germinate and cause infection on account of lack of moisture. Correlated with a heavier rainfall, potato blight is generally more severe in the west of England than in the east.

In temperate regions epidemic plant diseases are often checked by the oncoming of winter, during which most of these parasites are not present in an infectious condition. Mildews which are propagated in an epidemic manner during the summer by spores of a delicate nature, usually form another type of spore towards the end of the growing season, which is enclosed in an impervious case that remains sealed until the following spring. At the same time the young stems and leaves, which are the parts chiefly liable to infection by such fungi, either do not exist during the dormant season or have become greatly modified in structure. In the tropics, however, vegetation and weather conditions are both often practically uniform throughout the year, the temperature and rainfall varying but little in successive months. In such a climate there is no close season for fungal parasites and epidemic diseases are greatly to be feared.

The sources of infection of epidemic plant diseases are sometimes mysterious, and much further work is

required in order to elucidate them. Many investigations have been made upon the means of overwintering of *Phytophthora infestans*, and still there is obscurity about it. Recently it has been shown that the mycelium of this fungus possesses a limited power at any rate of saprophytic development in the soil, and it may be that this is one of the ways in which the fungus survives under natural conditions, especially in such warm areas as the Penzance district and the Isle of Wight. It may be that the fungus is really endemic in such centres in a manner somewhat similar to the continued occurence of cholera in certain districts in India in years when the disease is not epidemic.

The balance between host, parasite and environment in the causation of epidemic disease is usually of a delicate nature. A slight change in environmental conditions, which may favour the host or alternatively injure the parasite, may be quite sufficient to prevent the establishment of an epidemic. Thus *P. glumarum* is commonly present in epidemic form on wheat in this country, because the temperatures of the winter are usually insufficiently low to kill the uredospores of this fungus. *P. graminis*, on the other hand, is a comparatively rare fungus here (except on cereals in immediate association with barberry bushes), because its uredospores cannot survive the winter temperatures which are harmless to *P. glumarum*.

There is some evidence, perhaps of a not very critical nature, that the parasite itself may be more virulent at certain times than at others. There is a parallel to this in certain human diseases. For instance, during the last few years there have been successive waves of influenza, some of which were much more virulent than others. This was probably due to variations in virulence of the bacteria causing the disease, although it may be argued that this phenomenon resulted from a special degree of susceptibility on the part of mankind at the time of most serious attack. With plant parasites it is often found that, upon introduction into a new country, they spread with great rapidity during the first few years until a climax of intensity is reached, after which their attack is less serious. Thus potato blight was introduced into Europe during the early part of the nineteenth century and rapidly spread so that in 1840 it was responsible for a complete failure of the potato crop in Ireland, thereby causing a serious famine; it is doubtful whether this fungus has ever been so virulent since. Another illustration may be taken from a disease which has been introduced into this country in recent years. About 1900, American gooseberry mildew became accidentally established in the British Isles, and immediately began to spread rapidly, so that in a few years all fruit areas where gooseberries were grown on a large scale were attacked by the disease. After some years, however, this parasite became less prevalent, and it may be that its period of maximum virulence has passed, although there has been a considerable recrudescence of the disease during 1922 and 1923.

The example of American gooseberry mildew is an illustration of the danger of the introduction of a parasite to a country where it is not native. Sometimes the climatic and other conditions of the new country are unfavourable to the parasite, but frequently it is otherwise, when there is grave risk of the establishment of disease in epidemic form.

Again, when a new plant is introduced into a country, a parasite often attacks it violently, although the pest has only been found hitherto sporadically upon related indigenous plants. Coffee was introduced into Ceylon as a plantation crop about 1870, and an important industry sprung up in connection with it. Soon, however, it began to be attacked by a fungus disease (*Hemileia vastatrix*), which up to that time had only occurred to a slight extent upon jungle plants closely related botanically to coffee. With large numbers of plantations in close proximity to each other, the disease spread rapidly and became so uncontrollable that coffee growing in the island became unprofitable. Heavy losses were incurred, and a few years after the commencement of the epidemic, coffee ceased to be grown on a commercial scale in that part of the tropics. That is an illustration of the danger of disease breaking out in epidemic form upon a newly introduced economic plant, the disease itself, although indigenous, being of negligible importance until the appearance of the specially susceptible plant.

Epidemic diseases of plants are disseminated in various ways. Most of the parasites produce spores which can retain their vitality for considerable periods unless exposed to extremes of temperature, insolation or desiccation. Many of these diseases, therefore, can be distributed over relatively wide areas by means of wind currents. With such a disease as potato blight this is undoubtedly the chief means by which the fungus is spread in an epidemic condition. Upon first development of the fungus in an active or sporing state in any season, the disease in its initial stages is present only on a few plants in the crop. Spores are produced on these plants and are then distributed by wind so that other plants in the vicinity become infected. The same considerations apply to mildews and rust fungi. The power of wind, however, to disseminate fungoid diseases over immense areas has undoubtedly been exaggerated. It used to be thought that disease could be spread in this manner from one country to another over wide tracts of sea, but this has been shown to be untrue. Delicate fungus spores which have been in the air a long time have probably been exposed to many vicissitudes of temperature, insolation and desiccation. These changes greatly impair their vitality and by the time they reach a plant susceptible to infection most of them are dead. It has been demonstrated for instance that bacterial germs are rapidly killed by exposure to strong light, and doubtless the same applies to many fungus spores. Furthermore, spores being light bodies are to a great extent carried by convection currents to the upper atmosphere, where conditions are of a more extreme nature, and from which many of these germs will not fall in a living condition.

Nowadays emphasis is laid upon the need for contact in the dissemination of many parasitic organisms. By maintaining contact is meant, bringing the parasite into the immediate vicinity of a

healthy and susceptible host by means of some living or mechanical agency. This has long been recognized in human diseases, for, in many of these, individuals only become attacked by coming into close association with others already affected, notwithstanding the fact that the germs of many of these diseases must be commonly present in the air. The inability of the germs casually present in the air to cause infection is due partly to the fact that their vitality is rapidly destroyed by exposure to bright sunlight and partly to the germs being present in quantity less than the minimum requisite to cause infection. In connection with the point last mentioned, it is a well-known axiom in medical science that the danger of infection increases with the magnitude of the dose of the disease, so to speak, to which one is exposed; there is no doubt, for instance, that even the healthiest man would succumb to tuberculosis if he inhaled an atmosphere saturated with the tubercle bacillus. With plant diseases the same principles are only just beginning to be recognized. The means by which the germs of these diseases are brought into contact with their hosts are often different from those of animal diseases, but they are none the less sure. It is now known that many infectious plant diseases are chiefly spread by *insect agency*, and occasionally by birds. There is a widespread group of plant diseases of great economic importance, known as mosaic diseases, which are characterized first by a mottling of the leaves with yellow spots and then by general degeneration. No organisms have yet been isolated which can be considered the cause of these diseases, but if the sap of an affected plant is inserted into a healthy one, the latter soon becomes diseased. Such diseases and others of a similar nature are known as viruses. They are of common occurrence in animals and are often supposed to be due to organisms of ultra-microscopic size. Foot-and-mouth disease in animals and the mosaic diseases in tobacco and potatoes are maladies of this nature. Mosaic disease of tobacco is one of the chief factors limiting the growth of the finest kinds of tobacco in those regions of the tropics, such as Sumatra, otherwise favourable for their growth. It has been shown recently that these mosaic diseases are largely spread by means of insects, especially by aphides, which, having visited diseased plants, puncture healthy ones, and thereby insert the virus. Apart from mosaic diseases, insects play an important rôle in the dissemination of plant maladies caused by known parasitic organisms, whether bacteria or fungi. The insect in sucking or biting the tissues of a diseased plant inevitably comes in contact with the germs of the parasite, some of which adhere while it passes to another plant, which may thus become infected. In fact, so intimate is the incidence of certain insect and fungus pests, that widespread opinions prevail amongst cultivators that fungi inevitably follow particular insects. One of the commonest diseases of apple trees is "canker," caused by the fungus *Nectria galligena*, which sometimes follows in the wake of woolly aphis, one of the most serious insect pests of apple trees. This sequence is probably assisted in two ways, first by the insect carrying the spores of the fungus entangled in its woolly appendages, and secondly because the insect punctures the bark, thereby creating wounds by which the fungus can invade the branches. Again, in the rubber plantations of Malaya, one of the diseases of rubber trees is an affection of the bark, which is brought about frequently by the combined action of an insect and a fungus. The insect is a boring beetle which usually attacks only dead wood, but which under certain circumstances invades the bark of living rubber trees, especially if this has been exposed to injury. In the dead wood inhabited by these borers the fungus *Ustulina zonata* is often found growing as a saprophyte, and as the boring insects pass from the dead wood into the living rubber trees they carry with them the fungus which, upon being thus established in the tissues of the rubber trees, spreads rapidly and acts as a destructive parasite. Such instances could be multiplied many times.

Annotations.

Latah in Tripolitania (T. Sarnelli, *Giornale di Medicina Militare*, fasc. II, 1924).—Latah has been described by several authorities on tropical medicine, but the form which is commonly seen in Tripoli resembles that described by Castellani ("Manual of Tropical Medicine," Ed. 1919) as "a mental condition in which suggestion is at once followed by uncontrollable action in the form of echolalia or echokinesia, of which the mind is usually, but not always, conscious." To the usual exciting causes, i.e., auditory, visual, tactile, Sarnelli adds a fourth —emotional. The predisposing cause is racial. The southerners are more frequently attacked, having a very excitable nervous system.

Observations on North China Intestinal Parasites of Man (Ernest Carroll Faust, *American Journal of Tropical Medicine*, July, 1924. Reprint.)—An intensive study of third-class patients on the medical service of the Peking Union Medical College Hospital was undertaken to determine the importance of parasitic infection in clinical diagnoses in North China. Sixty cases were studied. Each case was under careful scrutiny for a period of ten days or more, during which time every stool passed by the patient was examined. In all, 1,409 stools were studied, or an average of 23·48 per patient. Controlled methods of preparation of the stool for examination indicated that concentration methods were valuable only where a single specimen of stool was available for study. In cases where large numbers of stools of the same patient were examined concentration methods added only 10 per cent. to the findings. Forty per cent. of the infections were diagnosed after the first day, 35 per cent. of which were diagnosed first from unconcentrated preparations. Eighty per cent. of the cases studied were found to be harbouring intes-

tinal entozoa. While this infective incidence is comparable to that of a sick population in Central China, it is less intensive than the latter. The respective indices for the two areas are as follows: Central China, protozoa, 228·7; helminths, 234·3; North China, protozoa, 101·6; helminths, 88·03. The clinical significance of the study is demonstrated by the fact that 53·3 per cent. of the series harboured clinically important parasite infections. Twenty per cent. of the cases had a major diagnosis due to parasites; 46·6 per cent. had a minor diagnosis of parasites; 13·3 per cent. of the cases had both major and minor diagnoses occasioned by infections of the digestive tract due to parasites. No proof can be advanced from the study regarding flagellate entozoa in amœbic dysentery that there is a necessary relationship between the two infections. In the cases studied at least 89 per cent. of the patients secured their infections in the North China mesogeographic area. They belong to the lower middle class and the poor class, which groups, on account of under-nourishment, are likely to be more troubled with clinically important infections than are the upper classes. The Chinese, as a people, are not less susceptible to parasitic infection than other peoples, although light infections among Chinese are less likely to be clinically significant than in Occidentals living in China. Improper disposal of night-soil is responsible for all of the helminthic infections in the intestinal tract of man in North China as determined by this study.

The Dysenteries of Cochin China (N. Bernard, J. Bablet and R. Pons, *Arch. des Instituts Pasteur d'Indochine,* April, 1925).—Dysentery holds first place among the endemic diseases of Cochin China, and the number of deaths from it are not few, although they have gradually decreased during the past few years, thanks to the valuable observations carried out by French and other investigators. Since 1918 the Pasteur Institute at Saigon has carefully investigated the subject, and some important results have been obtained. The authors give a very interesting historical account of the disease in Cochin China, and describe the various types found there. The presence of alkalinity, in a pathological stool, contrary to general opinion, is of first importance; it often coincides with the appearance of grave symptoms and disappears with them. Emetin is of great value in the cure of the disease, but its preventive action is almost *nil*.

Malaria in the Kirkuk Division of Northern Mesopotamia during 1923 (William Corner, O.B.E., M.D., *Transactions of the Royal Society of Tropical Medicine and Hygiene*, March and May, 1925).—The main features which have been noticed during 1923 with regard to malaria in the Kirkuk Division of Northern Mesopotamia in dealing with indigenous natives, treatment and preventive measures not being touched upon, are the following: There are two malaria seasons, the main one in summer and a lesser one in the late autumn. The summer malaria season lasted roughly from the beginning of June to the middle of August. It was caused by the malignant tertian and to a less extent by the benign tertian parasite. The autumn malaria season occurred in late October and November, being most marked in the first half of the latter month. It was due to the malignant tertian parasite. Malaria in 1923 showed certain features which were the outcome of malaria in the preceding summer, when it was prevalent in epidemic form. The chief feature was the marked prevalence and predominance of residual quartan malaria, which existed during the first five months of the year until the starting of the malaria season. It is judged that normally quartan malaria is a comparatively common infection, and that fuller explanation of the marked quartan predominance referred to is that it was due to residual infections from an epidemic year occurring in an area where quartan is peculiarly common. Quartan malaria was not confined to any one part of the division, but was equally prevalent everywhere. Malignant tertian was the main cause of the summer and autumn malaria seasons. Infections started somewhat later than the benign form (roughly, fifteen days) and rapidly disappeared with the passing of the malaria season. Crescent infections were comparatively not common. The main clinical manifestation was a quotidian fever of no great severity. Pernicious forms were absent. Benign tertian was the earliest infection to appear in any number with the opening of the malaria season. This parasite seemed to depart markedly from its usual rôle as a cause of relapses, its behaviour as regards disappearance of infection at the end of the malaria season closely resembling that of malignant tertian. There was no evidence that benign tertian was a factor in the autumn malaria season. Quartan malaria—presumably its season of infectivity coincided with the summer malaria season. This, however, could not be proved, fresh cases being obscured by the mass of already existing quartan malaria. Triple infections were comparatively common, especially in the early months. Double infections are common. Quartan malaria, as met with, has quite sustained its reputation as the cause of an extremely chronic infection.

Nomadic Arabs on the whole suffer very little from malaria. Its occurrence can be explained by their habits. During both the summer and autumn malaria season they are in fixed camping grounds, and according to the malarious nature of these grounds so will malaria among them vary. Malaria was most seen in small sections which camped alongside the fringe of villages on the edge of the desert, to the west of Kirkuk and Taza Khurmatu. The Quaraghan-Kifri-Tuz-Tauk-Taza-Kirkuk-Alton Keupri road serves as a rough line of division of malarial endemicity. On the east, or hilly side, malaria is hyperendemic and shows very high spleen-rates. The area to the west, or desert side, shows medium spleen-rates passing to low or *nil* the further

one goes into the desert. Malaria in the Kirkuk division seems to be associated with (*a*) a higher degree of splenic enlargement than that usually recorded; (*b*) very high spleen-rates among the children and often a comparatively high spleen-rate in adults; (*c*) a surprisingly low parasite-rate in children and adults considering the high spleen-rate. The theory is advanced that (*a*) is due to the prevalence of quartan malaria. It is also possible that this fact also contributes to (*b*) and (*c*). Each malaria season was preceded by a marked increase of mosquito-breeding, including *Anopheles*. A feature of the main malaria season was the fact that it lasted throughout the hottest and dryest month of the year, when the 8 a.m. mean temperature was about 90° F. and the mean relative humidity was below 30 per cent. Humidity, within limits, appeared to be a factor of comparatively little importance in influencing malarial prevalence.

Vaccinotherapy in Gangrenous Affections of Fuso-spirillar Association by an Antispirillar Vaccine (R. Pons, *Arch. des Instituts Pasteur d'Indochine*, April, 1925).—The pathogenic action of the spirilla is comparable to that observed in fuso-spirillar affections, in which the spirochæte plays the most important rôle. The germ used as an antigen in vaccination differs from *Spirochæta vincenti* in its dimensions and its cultural properties, but it cannot yet be determined whether or not antigen properties exist which are common to both germs. Antispirillar vaccine has a rapid action on the phagedenism in all cases; four to five injections are enough to put a stop to it. Complete cure of the ulcers is sometimes long, depending largely on the general condition of the patient and on the lesions. The rapidity of the cicatrization of the mucous ulcerations is remarkable.

Raynaud's Disease complicated with Gastric Ulcer (Julius Friedenwald, M.D., and William S. Love, Jr., M.D., *Journal of the American Medical Association*, July 11, 1925).—The case described presents a typical instance of Raynaud's disease complicated with gastric ulcer. While it is most difficult to demonstrate a definite relationship existing between the two affections as occurring in the same patient, it is extremely interesting to note, and it is quite possible to conceive, that both may have originated in a vascular spasm. That similar spastic manifestations of the blood-vessels occur in the internal organs in Raynaud's disease is revealed in the well-observed attacks of hæmoglobinuria and of abdominal colic noted at times in this affection.

Dochez Scarlet Fever Antitoxin in Thirty-one Cases (R. H. Graham, M.D., *Journal of the American Medical Association*, July 11, 1925).—Serum disease occurred in twenty-one cases out of a possible thirty-one. The size of the dose apparently did not influence the reaction. Immunization was established in twenty-four cases, all of those treated the day of exposure. Serum injected the second day after exposure did not protect two patients out of three. Therapeutic injections gave little apparent relief. One advanced case showed no improvement with 40 c.c. of unconcentrated serum, and there was a serious serum disease.

An Epidemiological Study in Leprosy (G. R. Callender, *Philippine Journal of Science*, May, 1925).—A brief study of some of the epidemiological aspects of the histories of 259 lepers has been given in an effort to stimulate the continuance of this method of research in leprosy in the Philippine Islands. Additional evidence is presented that the earliest recognizable lesion is an anæsthetic area. The data on the location of the primary lesion added to the data reported by others favour the theory that the organism enters the body through abrasions or similar wounds in the integument of the exposed parts of the body. The age at which the first symptom appeared in the cases of this series also agrees with the findings of others, that the more susceptible ages are in the first decades, although no age appears exempt, unless we extend the possible incubation period beyond reasonable limits.

Localized Gangrene Following the Hypodermic Administration of Calcium Chlorid (M. G. Seelig, M.D., *Journal of the American Medical Association*, May 9, 1925).—Calcium chlorid administered intravenously in strengths above 1 per cent. is not an innocuous drug. Solutions of 2 per cent. and over show a marked tendency to cause necrosis and gangrene when brought into contact with subcutaneous tissue. When solutions of such strength are used for intravenous administration, necrosis and gangrene constitute a very real menace, because of the danger of some of the solution escaping into perivenous tissues. The poisonous effect of calcium chlorid (marked cardiac depression) may be discounted in a large measure because the dosage commonly used is not large enough to cause toxic symptoms, particularly if the solution is administered slowly. The administration of a 1 per cent. solution (50 c.c. administered slowly) seems to be a very certain protective against all undesirable effects.

Effects of Obscure Lesions on Organ Weights of Apparently Normal Rabbits (Wade H. Brown, M.D., Louise Pearce, M.D., and Chester M. van Allen, M.D., *The Journal of Experimental Medicine*, August 1, 1925).—A group of 350 normal rabbits was studied with reference to the occurrence of obscure lesions of various kinds and the probable or possible effect of such lesions of various kinds or disease processes on organ weights. It was found that so long as the animals remained in apparently good health the values obtained for organ weights of animals with lesions did not differ materially

from those for animals that were entirely free from lesions. There were, however, slight deviations from the normal which appeared to be significant in that they suggested a functional response similar in character to the more marked changes in mass relationships that occur in rabbits presenting clinical symptoms of disease due to the same causes.

Clinical and Serologic Studies of Neurosyphilis with Tryparsamide Therapy (Julian Mast Wolfsohn, M.D., and Carlos Leiva, M.D., *Journal of the American Medical Association*, August 15, 1925).—In a series of thirty-seven cases of neurosyphilis, in all of which antisyphilitic treatment had been given previously, tryparsamide therapy combined with special technique has proved an apparent distinct advance over other forms of treatment. The improvements are most systematic. Tryparsamide in doses of 2·5 grm. may, and does, occasionally cause ocular symptoms, but not more often than do other arsenicals. Tryparsamide is one of the best tolerated of the arsenicals used in the treatment of neurosyphilis. Tryparsamide has little or no effect on the serological reactions in general paralysis. It is distinctly beneficial both clinically and serologically in certain types of tabes. Tryparsamide is a distinct addition to the therapy of neurosyphilis.

Viability of Bacillus Typhosus in Oysters during storage (Fred. O. Tonney, M.D., and John L. White, M.D., *Journal of the American Medical Association*, May 9, 1925).—The longevity of *B. typhosus* in the oyster juice of both shucked and shell oysters in storage varies with the temperature at which they are kept. In general, the temperature best suited for the preservation of the oyster tends to prolong the life of typhoid bacilli in the oysters. Under conditions simulating those of the trade, viz., at icing temperature (45° F.), typhoid bacilli survived for twenty-two days in shucked oysters and for sixty days in shell oysters. No evidence of bactericidal power or eliminative action against *B. typhosus* was observed in living shell oysters during dry storage at 45° F., the microorganisms survive for a longer period than the oysters.

The Reactions of the Miracidia of Schistosoma Japonicum and S. Hæmatobium in the Presence of their Intermediate Hosts (Ernest Carroll Faust, *Journal of Parasitology*, June, 1924).—A comparative study of the reaction of the miracidia of *S. japonicum* and *S. hæmatobium* in the presence of their intermediate hosts has thrown light on the exact relationship obtaining in these respective host-parasite cycles. The free-swimming infective miracidia of *S. japonicum* move about in the top stratum of water. Only those molluscs which pass through this stratum are exposed to infection even if they were otherwise capable of stimulating an attack by the miracidia. The free-swimming infective miracidia of *S. hæmatobium* are equally distributed throughout the water in which they hatch. All snails in the immediate vicinity capable of stimulating an attack by the miracidia are likely to be attacked and infected. Several closely-related species of operculate snails belonging to the genera *Katayama* and *Oncomelania* have been found to harbour *S. japonicum* infection. The active mechanism of the miracidium for the specific molluscan host is probably a chemotactic one, in which the mucous secretion is the substance involved. Although the host-parasite mechanism is based on a precise adjustment, the miracidium is capable of very wide accommodation as regards temperature and H-ion concentration.

A Note on the Viability of Bacillus Dysenteriæ (Hiroshi Kusama, *The Philippine Journal of Science*, May, 1925).—From the experiments on the viability of *Bacillus dysenteriæ* in artificial and natural dysenteric stools the following conclusions are drawn: Unlike the vibrio of cholera, *B. dysenteriæ* is fairly resistant to drying. It will survive longer in a sterile than in a normal fresh stool. *B. dysenteriæ* will survive a considerable length of time in water. In salt solution, and consequently in sea water, it will survive longer than in tap or distilled water. Physiological salt solution and bile are favourable media for the survival of *B. dysenteriæ* in the stool and the combination of the two may help to preserve *B. dysenteriæ* in the stools of dysentery patients and carriers, in at least a certain percentage of cases.

Some Clinical and Laboratory Aspects of Amœbiasis with a Preliminary Report on Yatren Treatment (John F. Kessel, Ph.D., and Otto Willner, M.D.).—The actual practical significance of the presence of *Endamœba dysenteriæ* in the stool is not altogether determined, although the old conception of the pathology produced by this organism is certainly far too narrow. To promote further study the laboratory diagnosis has to be put on a sound basis by creating a specially equipped protozoological laboratory in charge of an efficiently trained microscopist. The clinical observations should be made from a more uniform point of view and be guided by a detailed outline of study. With *E. dysenteriæ* present in the stools specific treatment should be given to (*a*) anyone showing symptoms possibly relating to amœbiasis, or (*b*) any healthy carrier who has a reasonable chance of not being reinfected. The toxic effects of emetine render its use indiscriminately in all cases undesirable. Of nineteen cases positive for *E. dysenteriæ*, which were treated with yatren, seventeen (92 per cent.) were negative to these organisms in follow-up examinations made from three to six months after treatment. These results indicate that yatren is a satisfactory therapeutic agent in the treatment of chronic amœbiasis. Preliminary treatment of acute

manifestations of amœbiasis with yatren indicates that it may even replace emetine-bismuth-iodide in amœbic dysentery.

Pathogenicity of Trichomonas Intestinalis (Hiromu Tsuchiya, M.D., *Archives of Internal Medicine*, August 15, 1925).—*Trichomonas hominis* is not a pathogenic but a harmless flagellate present in the large intestine. Whether they are present in large or small number, neither laboratory nor clinical pictures bear evidence conclusive enough to warrant pathologic diagnosis. Diarrhœa, mentioned by many as characteristic of trichomoniasis, has no clinical aspect in the series described in this paper; instead constipation is a common occurrence with diarrhœal history in the past. Furthermore, proctoscopic diagnosis emphasizes the fact that constipation is a usual accompaniment in these cases. Nervous systems and nutritional disturbances as manifested by these cases are attributed not to the presence of *Trichomonas hominis*, but to some organic or functional disorder or to constipation secondary to such. The intestinal flora is independent of the presence of *Trichomonas hominis*. The type of intestinal flora does not alter the number of the flagellates. Hegner's assumption in regard to albino rats is not feasible in its clinical application.

Abstract.

AN OUTLINE OF THE HISTORY OF PLAGUE IN HONG KONG.[1]

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The revival of plague is one of the most important and striking facts in epidemiology. In May, 1894, the world was alarmed by its severe outbreak in Hong Kong, in which year probably more than 5,000 persons died here of this disease, amongst a far smaller population than we have at the present day.

In the early days of the epidemic in this colony, the ætiology of plague being unknown, little was done in the way of quarantine. Hong Kong's unrivalled position as the centre of shipping in the Far East enabled plague to spread along maritime trade routes in the course of three or four years to a vast number of ports in many countries throughout he world, including Japan, the Philippines, the Pacific Islands, South America, Madagascar and Mauritius. Land-borne plague travels slowly, but it is rapidly disseminated by marine traffic.

India became infected, almost undoubtedly from Hong Kong, in 1896; the first cases occurring in Bombay. The Indian Empire offered a fertile soil, and plague caused the loss of more than ten million lives in the subsequent twenty years.

The plague apparently came to Hong Kong from the Province of Yun-nan, about nine hundred miles distant, where it was known for many years to be endemic. Interesting confirmation of the antiquity of plague in this part of China is contained in the information given me by a Chinese medical man, himself a native of this province. He says that a time-honoured curse, one of the worst in the wide range of Yun-nanese maledictions, is to call upon the gods to afflict one's enemy with Yang-tzu, the name by which the plague is known in the local dialect. In 1893, plague, known as Luen-tzu, was present in Pak-hoi; later it made its appearance in Canton, where it prevailed in the form of a severe outbreak. The first cases are known to have occurred several months before the commencement of the Hong Kong epidemic, and an enormous number of deaths, probably not less than one hundred thousand, were attributed to plague in that year, before the epidemic subsided.

There must have been a good deal of confusion as to the true nature of this disease at that time. Bubonic plague was present in Macao, an early Portuguese settlement on the estuary of the Canton River, in 1895. It is curious to note that it was undiagnosed as such, and was known as "foul-gas fever."

The Sanitary Board of Hong Kong was instituted in 1883, its activities being chiefly directed towards the scavenging of the city and the improvement of housing conditions. On the outbreak of plague in 1894, the board was enlarged and its scope extended to include anti-plague measures. The Sanitary Board has retained these functions, with little modification, to the present day. It is worthy of note that there was no law to enforce the notification of deaths at this time, and a medical officer of health was not appointed until the year 1895.

In spite of the existence of a Sanitary Board, it was generally conceded that the housing conditions and general sanitation of the city of Victoria at this time were deplorably bad, and that the colony was inviting pestilence.

The outbreak of plague threw a tremendous strain upon the small Government medical staff available, and members of the Army, Navy and police force were enrolled to cope with the various aspects of the epidemic. It is gratifying to read of the splendid conduct of these medical and lay volunteers, English and Chinese, who, almost without exception, showed the utmost courage under difficult and trying circumstances.

A silver medal was struck in their honour, similar to the usual war medal, and presented to all those who went through the 1894 campaign.

The united efforts of this improvised staff were directed almost entirely to treatment, and the provision of temporary hospitals on land and in the harbour; in addition to the inspection and disinfection of infected premises, together with other anti-plague measures as were evolved from time to time.

Meanwhile, the attention of the scientific world

[1] Abstracted from the *Journal of The Royal Sanitary Institute*, July, 1925.

became focused on Hong Kong, and research work was commenced, notably by Japanese medical men, who were quickly on the scene. The efforts of the Japanese bacteriologist, Professor Kitasato, were early rewarded by the discovery of the *Bacillus pestis* on June 14, 1894, at the Kennedy Town Barracks Hospital, Hong Kong.

The Government medical officers regretted that they were too busy looking after the sick to devote much time to research, and consequently the honour of the discovery of the plague organism fell to a visitor.

Bubonic plague has always been by far the most common type in South China. Primary pneumonic plague, together with its different mode of transmission was early recognized in Hong Kong. Considerable public sympathy was aroused by the death of the nursing sisters of the Government Civil Hospital in the year 1898, from pneumonic plague. Twenty years ago the coincidence of primary pneumonic plague was stated to be as high as 4 or 5 per cent. of the total cases, doubtless many of these were secondary pneumonic plague; it is certain that authentic cases of the primary pneumonic type have been of rare occurrence during recent years. This may be considered remarkable in view of the ill-ventilated houses and overcrowding which prevail.

A good deal of research was done in the colony by medical men of several nationalities, who were given every encouragement by the Government. Many of their methods and deductions have, however, been subjected to criticism.

A number of interesting and voluminous special reports on various aspects of plague were published here at intervals between the years 1895 and 1915. A list of these publications which I have consulted is given at the end of this paper.

The term "bubonic fever" was employed in several of the special reports, mainly on the ground of its supposed resemblance to typhus.

A peculiar Chinese document of "precious instruction to rescue the world" was circulated in 1894, purporting to be written by Kwan Tai, the God of War, through the medium of a "planchette." This curious publication gives, amongst other "revelations," a liturgy to be recited by those who would escape the disease, and prescribes some elaborate native medicines for its cure.

As previously stated, the plague bacillus was discovered in Hong Kong, and a mass of evidence collected and tabulated, but the majority of the early investigators seem to have been obsessed with the idea that bubonic plague was primarily a gastro-intestinal infection. They were never able to discard this view, and it was left to the Indian Plague Commissions to determine the rôle of the rat and the rat-flea in the ætiology of bubonic plague.

In the first plague report, issued here in 1895, Dr. Lowson, then in charge of the epidemic hospital, says: "The question of the infection of rats previous to the epidemic being noticed in human beings has been made too much of."

Dr. Hunter, the Government bacteriologist, also criticized and discredited the conclusions of Simond, published in 1898, that rat-fleas conveyed the infection from rat to man. These and similar statements were indeed unfortunate, though it is proverbially easy to be "wise after the event."

Research was conducted here in 1894 to determine whether the beaten-earth floors of infected houses contained the *B. pestis*. This kind of ground-surface was then very common in the poorer Chinese houses where the bulk of the cases occurred, and was usually soaked with excrement and filth. However, as far as plague was concerned, the results were negative.

A curious belief in the immunity of opium smokers was prevalent at this time, so much so that people crowded into the opium divans for refuge; living and sleeping therein. This was shown to be a false notion, and probably spread by those interested in the opium trade. Statistics showed that opium smokers and eaters were no more immune than the rest of the community. The authorities, however, put much more faith in tobacco as a prophylactic, and all the plague staff were allowed to smoke freely.

Contaminated water was blamed for a long while; this led to the closure of a large number of domestic wells, which were then very common in the city of Victoria. Even the water of the harbour was under suspicion, and was examined for *B. pestis*.

The view of infection via the alimentary tract, due to specifically contaminated food, was widely accepted for several years, though there were those who considered "emanations from the breath and skin" as being the most important ætiological factor.

Large numbers of animal-feeding experiments with plague material were undertaken, and colour was lent to the gastro-intestinal hypothesis, as many of the animals and birds died of septicæmic disease resembling plague. However, the results were inconclusive, and were eventually disputed in Hong Kong in 1904 by the present medical officer of health, who expressed his entire disagreement with this view.

It was reported at one time that the *B. pestis* was found in low grades of Chinese rice. In connection with this view of the specific contamination of food, it was thought that possibly the plague bacillus might exist outside the body, in symbiotic union with certain of the vegetable moulds.

The sanitary state of Hong Kong in the plague year was wretchedly bad, particularly in the central districts of Victoria. The habits and surroundings of the Chinese were admittedly filthy in the extreme. Back-to-back houses were common, and these houses were of a very bad type, built like tunnels, often dilapidated and obstructed with cubicles and cocklofts, i.e., intermediate floors. The houses were damp, overcrowded, and almost entirely deprived of ventilation and light. Latrine accommodation was inadequate and drainage was bad or absent.

The first efforts at plague prevention were directed towards improving this state of affairs. The sani-

tary board acquired wide powers of dealing with insanitary areas, and at a later date attempted to improve the type of Chinese house, and compelled the provision of open space at the rear of buildings.

About ten acres of the most densely populated part of the city was resumed by the Government at the height of the epidemic. All the inhabitants were evicted and housed elsewhere. The streets were walled up and guards were stationed to prevent ingress.

Plague was made compulsorily notifiable, but this law was widely evaded. Inspection and registration of common lodging houses and coolie houses was enforced.

It was considered that the public latrines were possibly one of the most potent factors in the spread of the disease and chlorinated lime was freely used in these buildings.

House-to-house visitation was instituted to discover those dead or infected with plague; obvious cases were removed to the improvised hospitals or to the " Hygeia," a hospital hulk which was moored in the harbour near West Point. Suspects were sent to the Tung Wah, a large Chinese hospital, for observation.

Contacts in these infected houses were provided with clean clothes, their own clothing was removed, together with bedding and similar material, and sent to the steam disinfecting station, the clothing being tied up in sheets dipped in a solution of Jeyes' fluid and conveyed through the streets in closed baskets.

There were mat-shed shelters available for those whose houses were undergoing disinfection; the contacts were not detained, but were allowed to go about their business.

Houses in which cases had occurred were disinfected by spraying the walls with a solution of perchloride of mercury, one in a thousand; or by fumigation with free chlorine, generated by mixing common salt, manganese dioxide and dilute sulphuric acid in requisite proportions, producing a continuous liberation of the gas for some hours. Floors and furniture were scrubbed with a solution of Jeyes' fluid, 5 per cent., and the walls were then limewashed, chlorinated lime being added in the proportion of one pound to the gallon of limewash.

Extraordinary precautions were taken in the disposal of the dead; special plague cemeteries situated at a considerable distance were allocated for their burial, and it was a rule that the graves should be covered with six inches of cement mortar or similar material.

Inoculation with what is described as " Haffkine's prophylactic fluid " was introduced in 1902, and in that year 587 persons, mostly employees of the Board, were inoculated. Inoculation was made a condition of employment in the case of disinfecting coolies, rat-catchers and case-removing coolies. As far as was known, plague did not occur in any of these persons, though the vaccine frequently produced a violent reaction and some disability. In spite of generally favourable reports, the public took little or no advantage of preventive inoculation.

Yersin's serum was brought here at an earlier date. In 1896 Dr. Yersin came to Hong Kong with a supply of serum for the treatment of plague, but there were no suitable cases in the hospitals at that time, and he went on to Amoy to carry out his tests.

Various modifications in prophylaxis were adopted from time to time, as a result of experience. Many of the early methods were expensive and comparatively futile in the light of later knowledge.

The fumigation of houses with chlorine gas, produced by the action of dilute acid on chlorinated lime, was tried on a large scale. The difficulty of effective fumigation of Chinese houses by this means was, however, recognized, as was also the possibility of vermin escaping destruction in the joints and crevices of the woodwork and furniture.

A recommendation was later made to the Government to introduce a portable Clayton gas apparatus, which could be conveyed on a lorry to houses requiring disinfection, but the hilly nature of the city and district rendered this suggestion impracticable.

The systematic disinfection of the town was attempted, but proved a very costly undertaking and was abandoned in favour of a scheme of " general house-cleaning," in which a staff of European sanitary inspectors and coolies was constantly employed.

Districts were treated in rotation, so that each tenement house was cleansed at least three times a year. This important measure is still being carried out with great success and with but slight modification. It has all the advantages of simplicity, efficacy and economy.

Each inspector is allotted a certain number of floors daily; the occupants turn out their household possessions, the floors and cubicles are washed out, and the bed-boards are cleansed in portable iron tanks.

An inspection is made for minor structural illegalities, rat-runs and similar holes are filled in with cement at once and all rubbish is carted away.

When first instituted soft soap and hot water were used, later a solution of carbolic acid, and now an insecticidal mixture, 1 per cent. kerosene emulsion, is employed.

Defects in premises, or breaches of regulations or by-laws, are recorded for the service of legal notices on owner or tenant for their remedy.

As soon as the importance of rats in the ætiology of plague became appreciated comprehensive measures were put into force for the abolition of hollow walls, ceiling and stair linings. Concrete ground surfaces and efficient iron gratings guarding openings into houses were required; lath and plaster walls were instituted, and attention was paid to proper drainage.

Rats were caught in large numbers, and subjected to routine macroscopic and microscopic examination. It had been a matter of observation for a long while that the mortality from plague amongst the rat-catchers was exceptionally high.

A reward of two cents, later increased to five

cents, per rat was given, but this had to be stopped when it was found that the Chinese were importing rats from Canton for the sake of the bonus.

The laying down of a rat virus (Danysz's), for the purpose of spreading fatal disease amongst rats, was advised, but the results were disappointing, and did not justify its general use.

Wholesale rat trapping and poisoning was not a great success, and met with a good deal of passive resistance on the part of the Chinese. The rat-traps distributed in the Chinese houses were usually found, on inspection, to have the springs of the traps released. The net result was that few rats were caught by this means.

Another unsatisfactory aspect was that the rat-catching coolies were often known to threaten to report plague-infected rats as coming from a certain house if "squeeze" were not paid them. Householders were often willing to pay this form of blackmail rather than submit to the inconvenience of disinfection, the up-rooting of floor-boards, removal of ceilings, and similar measures, which were enforced by the authorities in the case of premises in which infected rats were reported to have been found.

On the whole, it was considered a better policy to reduce the accessibility of rats to dwellings, workshops and warehouses; and, as far as possible, make such premises unattractive to them.

Apparently no special protective measures, such as have been employed in India, for food and grain stores and godowns, were devised or enforced locally.

General rat poisoning takes place throughout the colony twice a year, by means of pellets of barium carbonate and molasses; about 350,000 of these pellets, together with instructions in English and Chinese, are distributed to householders on each occasion.

Rat-boards coated with a mucilaginous mixture are also supplied on demand by the sanitary department.

The present system of "rat-bins" has encouraged the destruction of rats, and has eliminated some of the disadvantages which have been mentioned. Small iron bins containing kerosene emulsion are bolted on to lamp-posts and other prominent places, and an inscription in Chinese characters requests the public to deposit any dead rats therein. These bins are emptied twice daily; the rats, which are labelled with the number of the bin in which they are found, are sent to the mortuary for examination by the Government bacteriologist. All rats are examined macroscopically for signs of plague infection, and blood-smears and smears from the splenic pulp of 10 per cent. of the rats are examined microscopically for the *B. pestis* at the Bacteriological Institute.

The *Mus rattus* and *M. decumanus* are both common in the colony; they occur roughly in the proportion of two of the former to three of the latter; both are liable to infection.

Seven to eight hundred of these rat-bins are in use throughout Victoria and Kowloon.

Two or three thousand rats, probably only a small proportion of the rat population, are collected weekly in this manner, and examined for evidence of plague.

An infected animal cannot always be traced to the actual house wherein it died, but a valuable indication is obtained as to the district in which plague may be expected to occur. Houses in the close vicinity are subjected to individual inspection, the cleansing gangs may be diverted to the suspected district and other suitable preventive measures speedily put into force.

Certain of the local anti-plague measures, with slight modifications, have been employed in the Philippine Islands for some years with marked success.

Though there is still a great deal to be done before Hong Kong may be regarded as a health resort, nevertheless, the result of the effort during the past thirty years of the medical and sanitary departments in the case of this one disease is very striking. Other natural causes, well known in epidemiology, have doubtless contributed to this end, yet Canton, South China and the Straits Settlements had many cases of plague last year. It is noteworthy that amongst our closely-herded population, approaching a million, the incidence of plague has been gradually reduced, until at the present day we can claim that there has been no notification of either rat or human plague in the Colony of Hong Kong from September, 1923, until the present date.

Current Literature.

THE INDIAN MEDICAL JOURNAL
August, 1925.

A Preliminary Note on the Pharmacology and Therapeutics of Adhatoda vasica (Basak) (R. N. Chopra and S. Ghosh).—The chemical analysis of *Adhatoda vasica*, a small evergreen subherbaceous bush which grows all over the plains of India and in the lower Himalayan ranges, shows the presence of two active principles: (*a*) an alkaloid vasicine whose empirical formula is $C_{11}H_{12}N_{20}$=molecular weight. (*b*) Traces of a volatile principle of the nature of an essential oil. Vasicine has no marked action on the alimentary canal or on the circulation. It produces slight but persistent bronchodilatation in experimental animals and this effect is considerably increased after the administration of atropine. Clinically a fluid extract prepared from the leaves has well-marked expectorant properties and relieves bronchial spasm. It has no effect whatever in pulmonary tuberculosis.

Mercurochrome 220 *in the Treatment of Malaria* (A. Neave Kingsbury and K. Kanagarayer).—A case of benign tertian malaria is reported in which 0·3 grm. of mercurochrome was given over three days. On the withdrawal of aspirin and three days after the last mercurochrome injection a typical

rigor occurred with a temperature of 102·9° F. The malignant tertian case received a similar quantity of mercurochrome and fever recurred two days after the last injection. The dye appeared to have little effect on the number of malaria parasites in the peripheral blood and caused no modification in their standing properties. In neither case did albuminuria develop. It is considered that the action of mercurochrome on malaria parasites is practically negligible, and that, in view of the unpleasant sequelæ which result from its exhibition, it should not be given in cases of malaria fevers.

Excision of the Pineal Body of a Monkey under Intra-arterial Anæsthesia (J. P. Arland).—In this case the anæsthesia was very sound. The common carotid artery was clamped to shut off the blood current, in order to provide a bloodless field for the action of the anæsthetic. The presence of blood has a retarding influence on the power of the anæsthetic solution. The addition of gum acacia combined with adrenalin increases the duration of the anæsthesia. The internal jugular vein was clamped in order to lock in the injected solution as far as possible. No signs of shock were noticed either during or after the injection. The monkey recovered.

Cataract Extraction. Notes on 17,000 Operations (J. M. Macphail).—The author gives an account of his thirty-four years of work in the Mission Hospital, one of the three maintained by the Santal Scottish Mission, in Bamdah, a village in the Province of Bihar. Although the number of operations for cataract is high, the disease is not common in Bamdah; most of the cases are patients who have travelled long distances to be treated at the hospital, which is situated on a popular pilgrimage route. The chief cause for cataract appears to be the glare of the sun.

Treatment of Hæmorrhoids by Strangulation and Snipping Method (D. R. Kehar).—The author has treated about five hundred cases of hæmorrhoids, external and internal, during the last five years by the "strangulation and snipping method," and finds that the results are efficacious and long lasting. The patients treated were from 14 to 50 years of age and the hæmorrhoids were in all stages of inflammation. The patient can be discharged on the seventh or eighth day after operation. This method has also been found useful in cases of partial prolapse with piles.

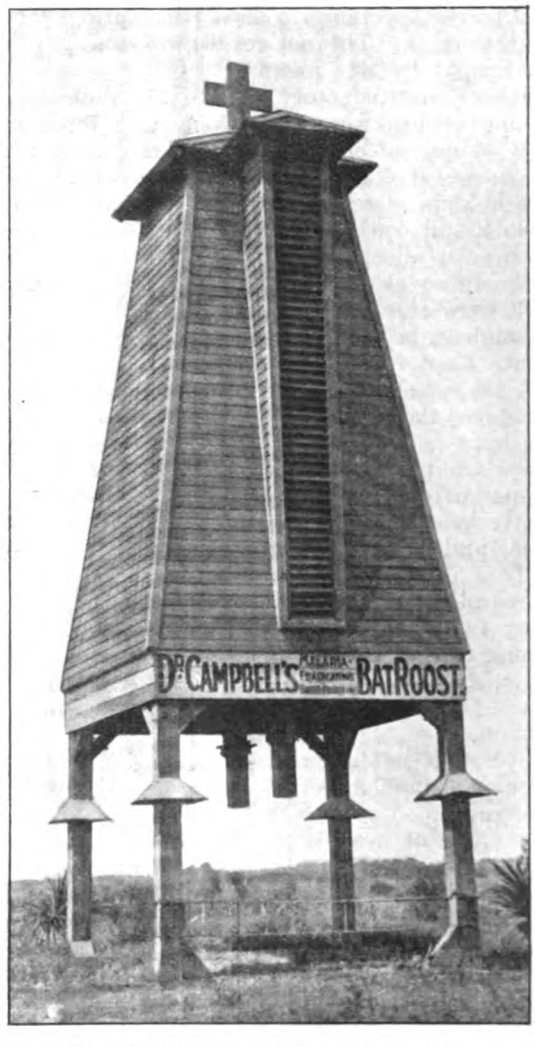
Correspondence.

To the Editor of the JOURNAL OF TROPICAL MEDICINE AND HYGIENE.

SIR,—I have recently returned from one of my trips to Texas, during which I was shown what appeared to me to be a rather original scheme for the extermination of mosquitoes in the neighbourhood of a large lake south of the city of San Antonio, where the insects bred in large numbers, causing a great deal of trouble for many years.

A few years ago, at the suggestion of Dr. Campbell, a local doctor, bat towers were erected, since when the insects have been practically exterminated. The towers, which are about 40 ft. high, are erected near the lake, and once the bats are introduced no further attention is called for.

The originator of these towers, Dr. Campbell, claims a certain royalty on each tower constructed,



Bat Roost, Mitchell Lake, San Antonio, Texas.

though I am not aware to which countries this would apply.

The cost of erection is about $2,500 each, including Dr. Campbell's royalty. In the present case the bats were in existence on the spot in small numbers, but they were made to congregate by a special bait which is only known to the originator and his family.

I am, Sir,
Yours faithfully,
(Signed) L. MAURICE COCKERELL,
M.I.M.M., &c.

Original Communications.

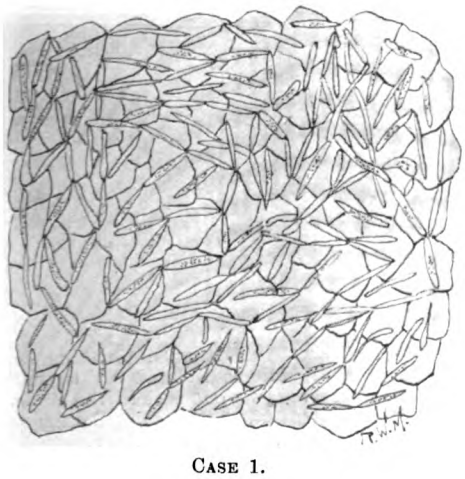
SOME INTERESTING DISEASES OBSERVED IN THE CLINIC OF THE BANGKOK CENTRAL HOSPITAL.

By RALPH W. MENDELSON, M.D., D.P.H.

(Principal Medical Officer of Health, Royal Siamese Government, Bangkok, Siam.)

SIAM offers a rich field for research in medicine, both tropical and cosmopolitan, but so far it has hardly been touched. The varied duties of the medical officer of health do not permit a serious effort in this interesting line of work, but advantage is taken to observe the patients presenting themselves for treatment in the Clinic of the Central Hospital. Here are to be seen between 19,000 and 20,000 cases every year. These patients come from every part of Siam and represent every grade in society. If one had the time I think it would be possible to fairly accurately describe every disease to be found in the country from observations in this clinic alone. For fear this statement may discourage the reader from continuing this paper I will at once state that such an ambitious programme is entirely foreign to the object of this article. It occurred to me that it might be of interest to report some of the more interesting cases that lend themselves to photographic study, and with the idea of making the report as attractive as possible the legend has been limited to a short description of each illustration. Interesting febrile and other conditions are necessarily omitted.

The frequency of dermatomycosis is the same in Siam as in other tropical countries. A great variety of unidentified fungi have been observed in these cases; an example is here shown.



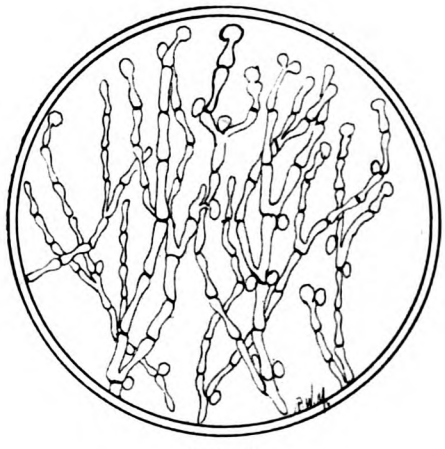
CASE 1.



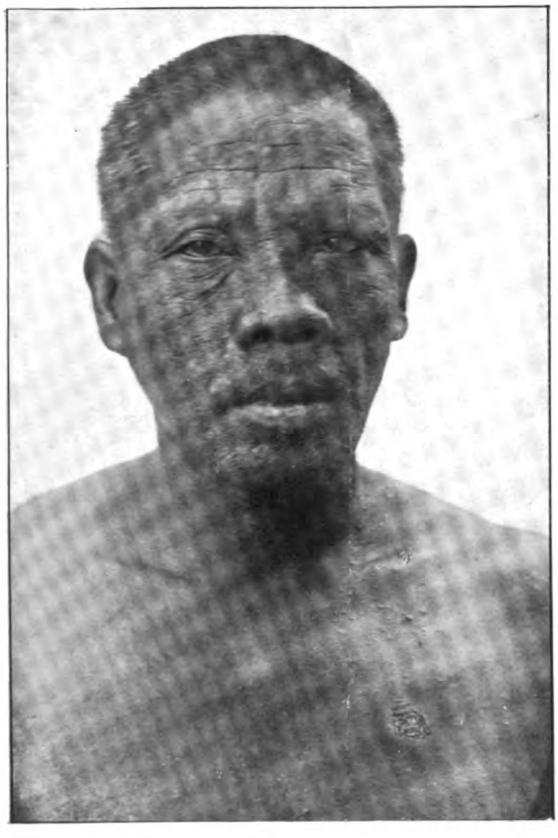
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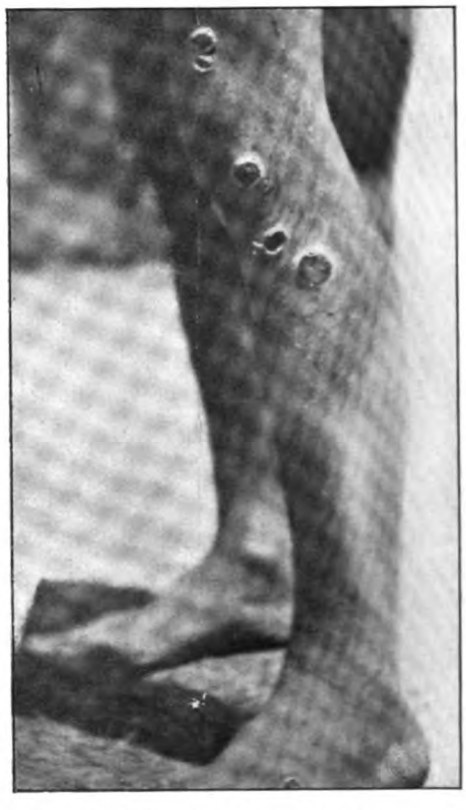
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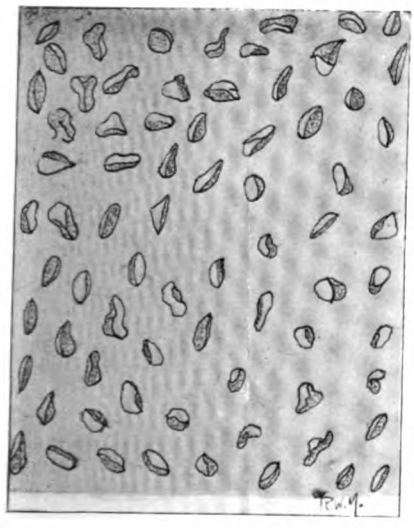
CASE 3.



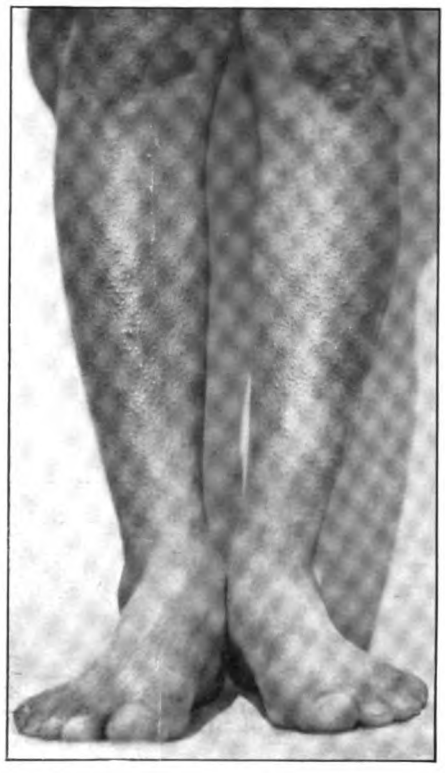
CASE 2.—Pityriasis nigra, caused by a fungus of the genus *Cladosporium—C. mansoni* Castellani 1905. A few cases have been observed.



CASE 3.—Acladiosis. This is an interesting dermatomycosis caused by a fungus isolated by Castellani in Ceylon. I have observed only one case in the clinic. It is caused by *Acladium castellani* Pinoy. Potassium iodid acts well, local treatment is unsatisfactory.



CASE 4.



CASE 5.—Keratosis pilaris, an inflammatory condition that is characterized by an accumulation of horny material in the follicular orifices. It produces a nutmeg-grater-like appearance. It is very chronic and does not respond readily to treatment.



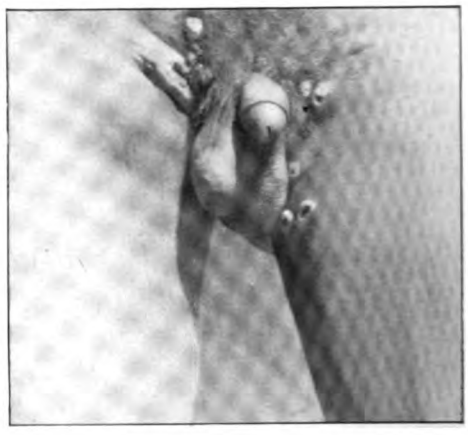
CASE 4.—Tinea labialis (betel-nut dermatitis of the lips). Due to an as yet unidentified mould that can be demonstrated in the betel-nut cud and the lesion. I have observed many of these cases. The condition has not been reported from other countries. May be caused by a variety of fungi.



CASE 6.—Tuberculosis verrucosa cutis. A few cases have been seen. The lesions begin as small papules, and increasing in number coalesce to form verrucose patches. Infection as a rule occurs from without.



CASE 7.—Xanthoma tropicum (juxta-articular nodules). A very common condition in Siam. Sections usually present the appearance of a hard fibroma, although various degenerative changes have been observed, fatty, amyloid, &c.



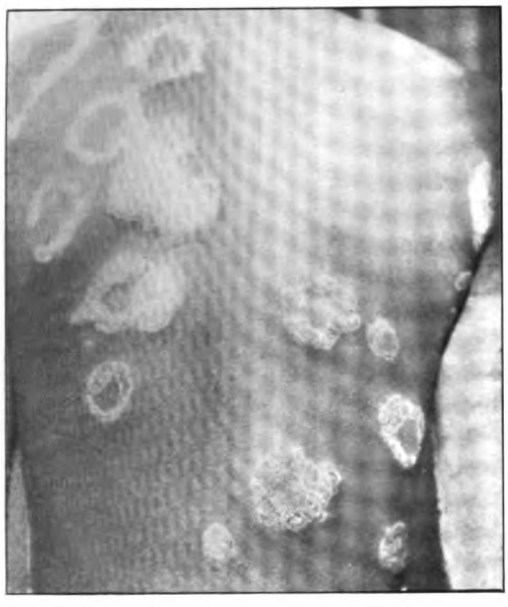
CASE 8.—A disease (dermatitis cupoliformis) first described by Castellani as occurring in Europeans resident in Ceylon and due to a streptococcus belonging to the erysipelatous group, called *Streptococcus tropicalis* Castellani, 1914. I have observed a few cases in native Siamese.



CASE 7.



CASE 9.—Vitiligo, a common condition in Asiatics. This particular photograph is that of an Indian patient in the insane asylum. The condition itself is probably a trophoneurosis.



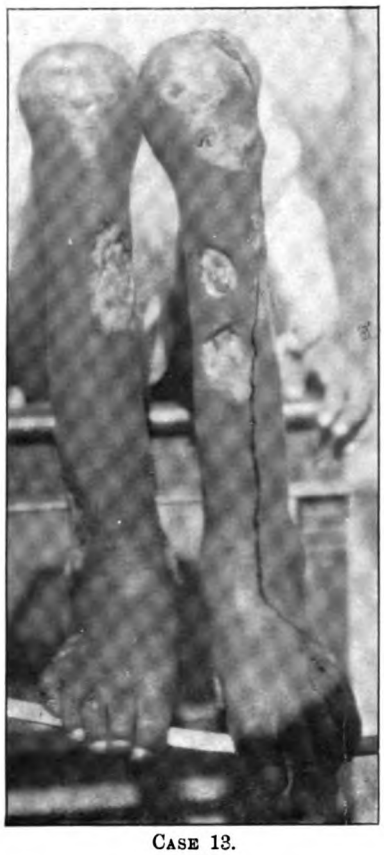
CASE 10.—Leprosy is very common in this country. I present this case as a very fine example of an acute exacerbation of an old chronic condition. This patient has suffered from leprosy for many years. He has never had any treatment except native. Three days before coming to the clinic he developed this very acute eruption on the various nodular lesions present.



CASE 11.—Elephantiasis, not common in Siam. This is a case of elephantiasis of the labium in which microfilaria could at all times be demonstrated in the peripheral circulation.



CASE 12.—Hyperpituitarism and hypopituitarism. These two patients came to the clinic within three days of each other, both from the interior of Siam. Patient on the left is 19 years old, 7 ft. 3 in. in height. Family history negative. Patient on right is 21 years old and 3 ft. 5 in. in height. Both exhibit the usual symptoms, and X-ray pictures confirm the diagnosis. One shows a very enlarged, the other a small pituitary fossa.



CASE 13.



CASE 13.

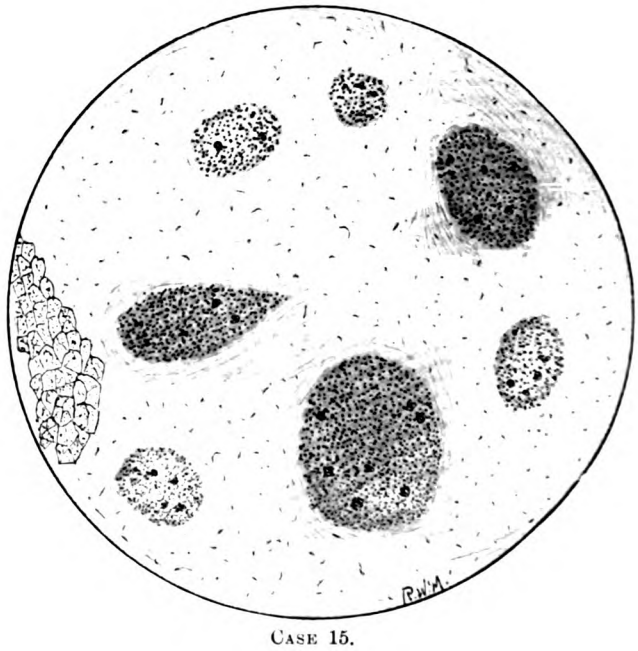


CASE 13.

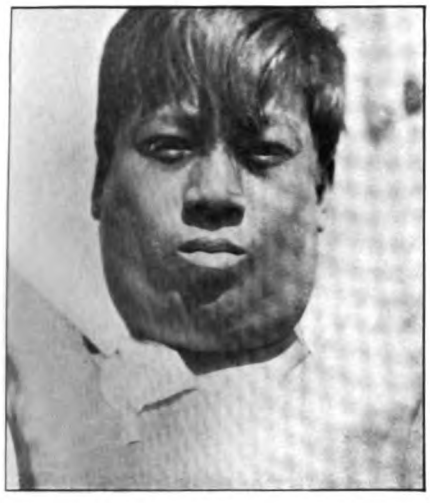
CASE 13.—Frambœsia tropica. A very common disease in Siam. Intensive treatment throughout the Kingdom will soon be taken up by the Department of Public Health. The photographs show the type of disease that is not uncommon. Have seen many cases that could be diagnosed as gangosa.



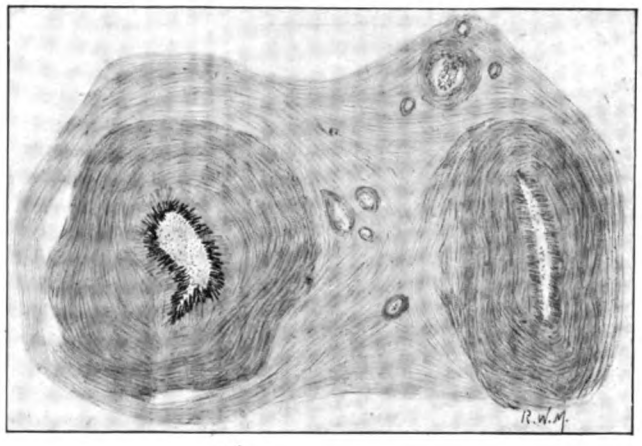
CASE 14.—Just to show the type of case that one sees in the clinic. Cysts of the ovary are common, but patients refuse operation until almost incapacitated.



CASE 15.



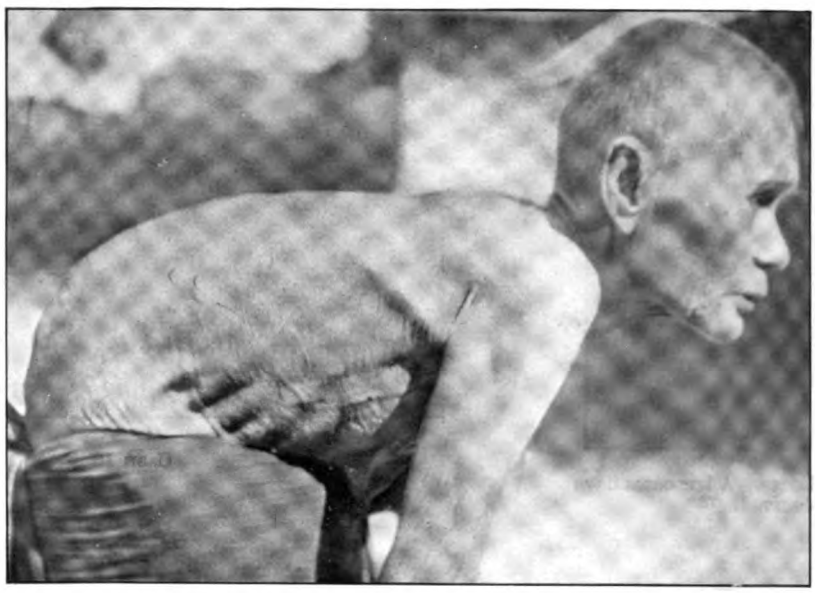
CASE 15.—Hodgkin's disease. A few cases have been observed.



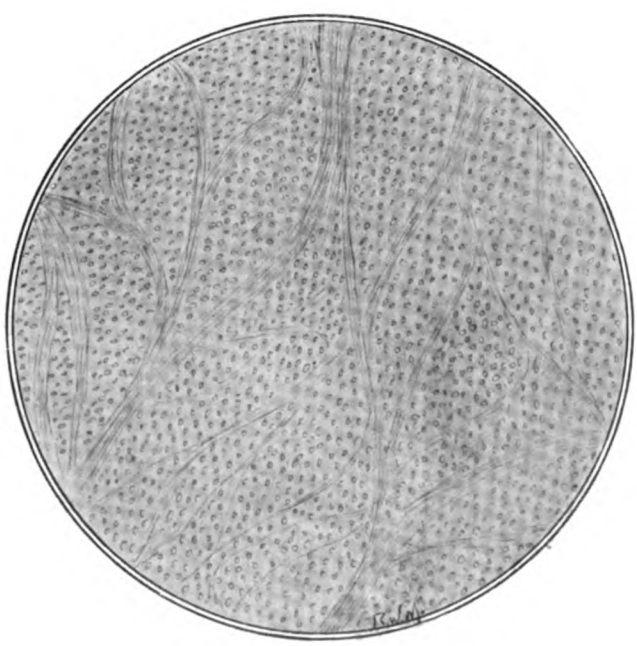
CASE 16.



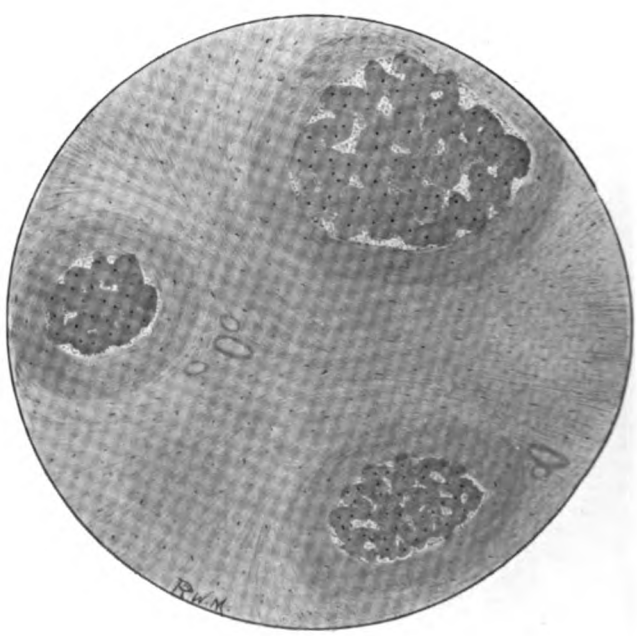
CASE 16.—Arteriosclerotic gangrene in a male Chinese aged 21 years. Patient died in hospital one week after being admitted. The section is from the tibial vessels. Notice the great increase in the muscular coats.



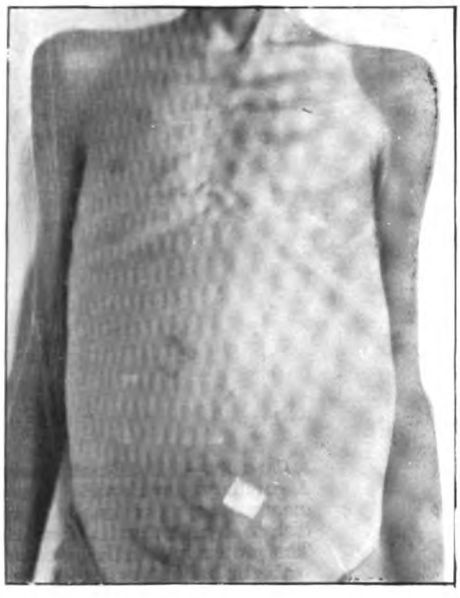
CASE 17.—Acquired kyphosis. The Siamese have a habit of resting on their haunches, especially the lower-class Siamese. This extreme type has often been seen.



CASE 18.



CASE 18.



CASE 18.—Tropical febrile splenomegaly. Cases observed both in Siamese and Chinese. Spleen puncture negative, although one genuine case of kala-azar has been seen. Patient claimed never to have been outside of Siam. Died in the hospital, and smears from the spleen were positive. This particular case is negative as far as bacteriological findings are concerned. The spleen and liver showed a high degree of fibrosis, characteristic of all of the cases that came to post-mortem examination.



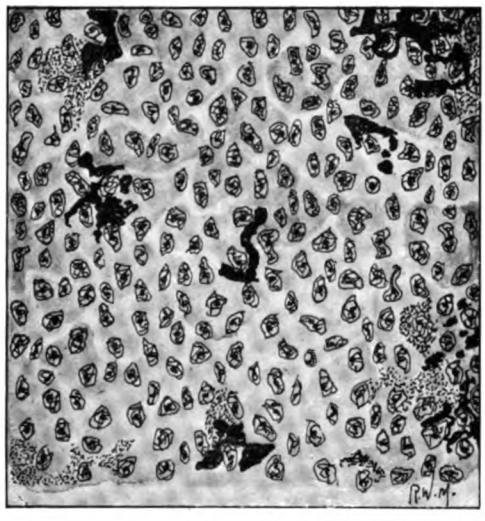
CASE 20.

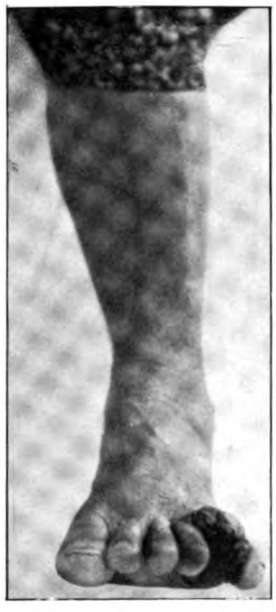


CASE 19.—Congenital bilateral ptosis. Have recently noted two cases. One in a female and one in a male. Treatment was refused as being too severe.

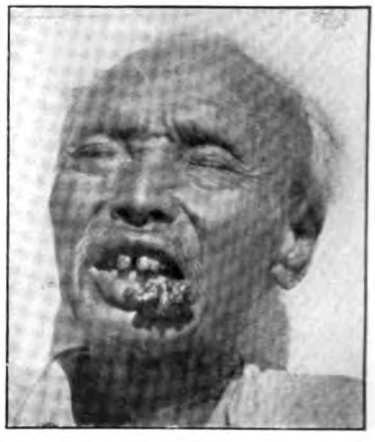


CASE 20.—Spindle-cell sarcoma of the jaw. This illustrates to what an extent a malignant growth may progress before the patient will seek relief.

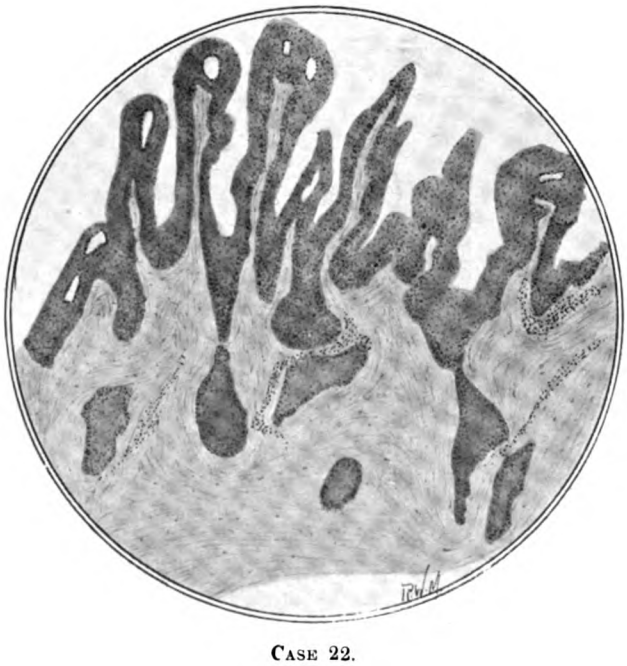




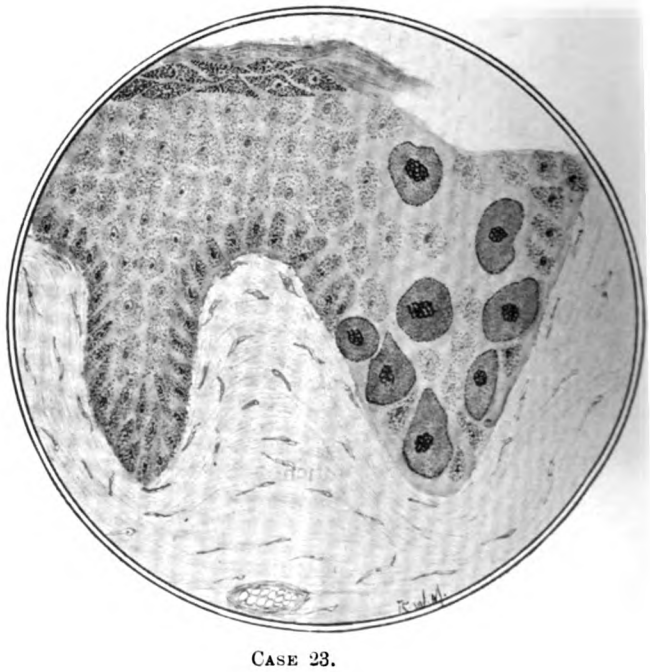
CASE 21.—Melanotic sarcoma of the foot. This patient also refused treatment. This growth, according to the history obtained, is of only three weeks' standing.



CASE 22.—"Betel-nut carcinoma." A papillary growth with late carcinomatous degeneration is a common disease in patients who chew betel-nut. The protruding teeth in combination with the irritant action of the mouth secretions must certainly have a determining action upon the delicate epithelium of the mouth and lips.



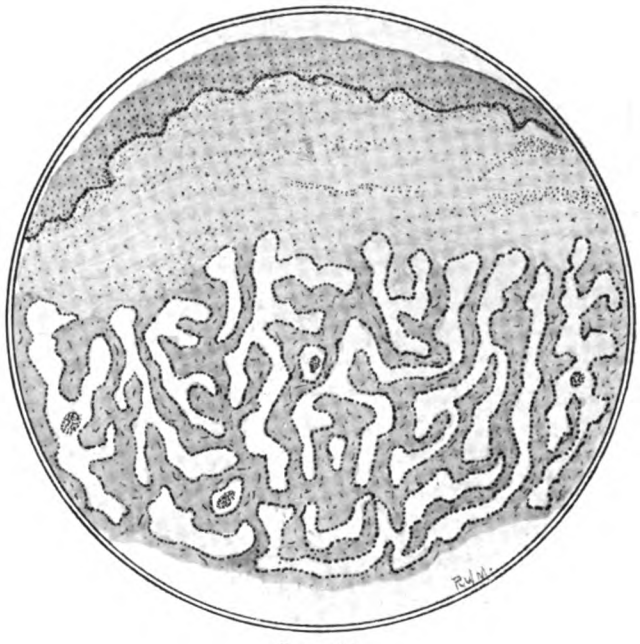
CASE 22.



CASE 23.



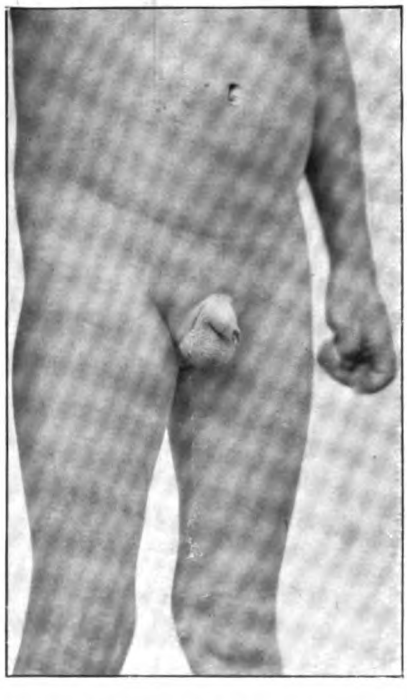
CASE 23.—Paget's disease of the nipple. This patient refused treatment after a section had been obtained for diagnosis. This is the only case I have seen here.



CASE 24.



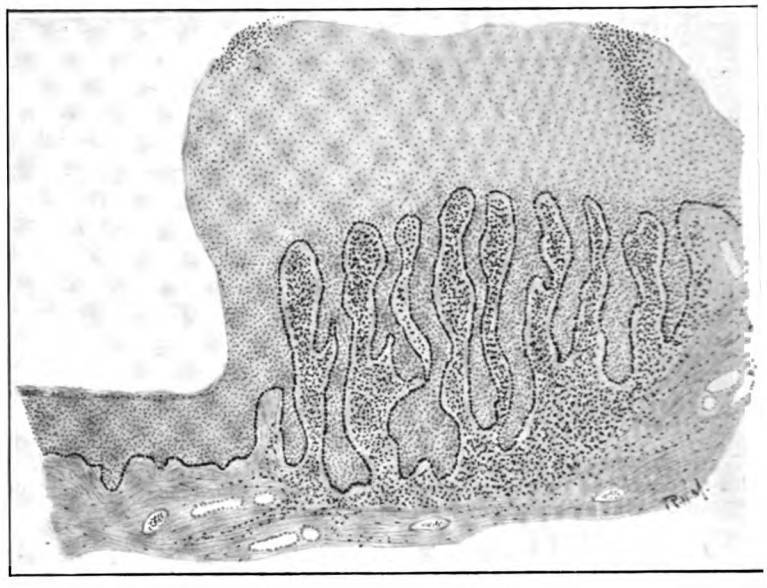
CASE 24.—Multiple papillary adenomata of the sweat glands. This is a rare condition. This type of growth is very apt to become malignant on account of the large amount of epithelium found lining the spaces in the tumour mass. The patient is a Siamese, male, aged 47. These tumours first appeared about seven years ago as very small subcutaneous growths. The one on the back had ulcerated and was removed with several of the others. They are extremely vascular and in excising them one must be sure to go a considerable distance beyond the growth in order to prevent copious bleeding.



CASE 25.—Climatic bubo. Not uncommon. This photograph is that of a Siamese boy, aged 16. The history and examination were quite negative. The boy had been ill some few days, slight fever and some pain. The swelling gradually cleared up under symptomatic treatment.



CASE 26.



CASE 26.—Granuloma inguinal. A few cases are observed every year. Whe permitted we excise the growth, as local treatment is unsatisfactory, patien becoming discouraged and refusing to return as requested.



CASE 27.



CASE 27.—Ulcus tropicum. Very many cases are seen in this clinic. We have had good results with protargol ointment, have treated some cases with salvarsan, but have not noted the immediate results reported by other physicians.



No. 28 is an example of phallic worship. This lad is wearing these wooden penises to safeguard himself against evil spirits and incidentally to give him "strength."



No. 29 is that of a superstition regarding the ætiology of mumps. This lad has painted on his cheek the image of a tiger within a circle. He is under the impression that the disease is in some way caused by rats and therefore by painting over the swollen gland a picture of a member of the cat family the evil spirits of the rats will leave him and he will recover.



No. 30.—This travelling dentist came to see us one day to inquire whether or not some of our patients needed the services of an expert. His credentials are in the form of strings of teeth extracted from unfortunate victims.



No. 31.—The young man in the picture is having his ears "manicured" in a local barber's shop. This is a common practice here and is the cause of considerable ear trouble.

SCHISTOSOMUM ? SPINDALIS MONTGOMERY IN A ZULULAND SCHOOLBOY.

By F. G. Cawston, M.D.Cantab.

In 1906 R. E. Montgomery [1] described a new schistosome from the mesenteric vessels of *Bos indicus* at Muktesar, India, which, in view of the spindle-shaped appearance of its ova, he named *Schistosomum spindalis*.

This schistosome was also reported from Sumatra [2] in the same year. In 1918 Lieut.-Col. Glen Liston and M. B. Soparkar [3] published a report of the life-cycle of this parasite, showing that *Planorbis exustus* served as the intermediate host in Bombay. They readily obtained the adult parasites from a goat; but failed to secure any from a monkey which was made to drink water swarming with cercariæ.

In the Annual Report of the South African Institute for Medical Research [4] for 1922, *S. spindalis* is reported as occurring in the urine of a patient from the Johannesburg General Hospital.

Ova resembling those of *S. bovis* Sonsino have been found in the urine of several patients at the Natal coast and in the Belgian Congo; but, until February, 1925, no ova resembling those of *S. spindalis* had been detected.

On February 9, 1925, a schoolboy of 14 came to me for treatment, complaining of four months' hæmaturia since bathing in the Umhlatuzi River in Zululand. There were no other symptoms. The urine contained numerous ova of *S. hæmatobium* and about a fifth the number of spindle-shaped ova, possessing a straight border when viewed from the lateral position, but presenting the appearance of the outline of those of *S. bovis* when viewed from above. The terminal spine was not heart-shaped as that of *S. bovis*. The fully developed ovum measured 0·24 mm. in length; but, as the extremities of the shell were solid, the miracidium did not appear to be much larger than that of *S. hæmatobium*.

The usual degenerative changes were observed in both varieties of ova whilst the patient was under intravenous antimony. No local or general toxic effects were noted throughout the series of injections, from a quarter to one and a half grains of the potassium salt being given to this schoolboy daily or on alternate days, until the urine was free from ova on the twenty-seventh day. In all he received a total of 17 gr., compressed 4 gr. tartar emetic tablets containing 2 gr. of sodium chloride being dissolved in 8 c.c. of boiling tap water just before the injection. No ova could be found in rectal washes or in the fæces, either by centrifugalizing or by the use of a saturated solution of salt.

Dr. W. F. Rhodes reported an eosinophilia of 11 per cent. during the first week of treatment. This might partly be due to the presence of *Ankylostoma duodenale*, which was the only pathological condition detected from examination of the fæces, and was treated with ol. chenopodium. He drew attention to the fact that the spindle-shaped ova showed much greater degenerative changes than did those of *S. hæmatobium* during the first week of the antimony treatment; this suggested that infection with *S. spindalis* would respond rapidly to antimony therapy.

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[1] Montgomery, R. E., 1906. "Observations on Bilharziosis among Animals in India," *Journ. of Trop. Vet. Science*, vol. i, No. 1, January, 1906.

[2] Vryberga. *Centralblatt für Bacteriologie Originale*, vol. xliii, 1906.

[3] Liston, Glen, and Soparkar, M.B., 1906. "Bilharziosis among Animals in India, the Life-cycle of *Schistosomum spindalis*," *Indian Journ. of Med. Research*, vol. v, No. 4, April, 1918.

[4] South African Institute for Medical Research, 1922. "Annual Report."

Some Recent Aspects of the Epidemiology of Clonorchis Infection in China (Ernest Carroll Faust, *China Medical Journal*, April, 1925).—Experimental study by Kobayashi and morphological study by Chen Pang of an extensive series of specimens from man and reservoir hosts of *Clonorchis* have demonstrated that a single species, *Clonorchis sinensis* (Cobbold), is present throughout the Far East. This parasite is present in a relatively large percentage of the coolie class as well as in the better classes of the native population in South China, but it is fairly uncommon in the indigenous population in the Central Provinces and is unknown as a parasite of man in North China. On the other hand dogs and cats are lightly infected in South China. In Central China they have an infection of 75 to 100 per cent. In North China the infection in the mammalian reservoir hosts ranges from 25 to 37 per cent. These varying incidences of infection are accounted for by the following facts:—

(1) Uncooked or insufficiently cooked fish is eaten by man only in South China.

(2) The fishes of Central and North China harbouring the encysted larva have the greater part of the infection on the underside of the scales and seldom in the flesh. In South China the limited examinations made justify the belief that the infection is mostly confined to the flesh.

(3) Although the only snail infected in Japan, Korea and Formosa is described as *Bythinia striatula* var. *japonica*, the parent form in China, *B. striatula*, collected from Soochow, Anking, Paotingfu and Peking has not yet been found naturally infected. On the other hand, *Melania hongkongensis*, collected near Shaohsing, has been found to harbour the fluke.

(4) Various fishes, both top- and bottom-feeders, have been found to harbour cysts of a fluke, proved experimentally to be *Clonorchis sinensis*. These cysts are resistant to drying, salting and putrefaction of the medium, but are killed in a short time by soaking in Chinese wine or vinegar.

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THE JOURNAL OF
Tropical Medicine and Hygiene
NOVEMBER 16, 1925.

GORGAS AND YELLOW FEVER.[1]

THE charming biography of Dr. Gorgas, which has recently been published by Marie D. Gorgas and Burton J. Hendrick, and should be read by everyone interested in tropical medicine, shows how, in the words of his biographers, "at every stage of his career William Crawford Gorgas seemed to confront the gaunt spectre of yellow fever." Nevertheless, Gorgas's first attempt to get to grips with yellow fever ended in failure. It was in 1877, while still a medical student at Bellevue, that the great yellow fever epidemic, which is still a horrifying memory to the older generation, started in Memphis. In company with half a dozen students he left for the plague-ridden city to offer his medical services. The authorities, however, met this group of pilgrims on the outskirts of the town, thanked them for their generosity, but refused to grant them admission.

In 1882, soon after he had qualified and joined the medical department of the United States Army, he was sent by the chief surgeon of the department as the most progressive young surgeon under his command to deal with a yellow fever epidemic which was then raging at Brownsville, on the Rio Grande, although at that time he himself had never had yellow fever, nor had he even seen a single case. During this epidemic Gorgas was himself stricken with yellow fever, and had a severe attack. Fortunately for mankind he recovered, and thus became immune to the disease for the remainder of his life. From now onward the Government summoned him wherever yellow fever appeared, and he was twice sent to Barrancas, in Florida, to deal with outbreaks of the disease, and so successful was his management of these epidemics that he gained much reputation in Army circles.

In 1898 Gorgas was appointed chief sanitary officer to Havana, the home of endemic yellow fever. The city, which now came under the jurisdiction of Gorgas, was little better than a huge cesspool. At this time yellow fever was looked upon as a "filth disease," and so Gorgas, who had been sent to Havana to eradicate this disease, placed his chief reliance in general sanitation. As Gorgas surveyed the rotting city its most pressing need was only too apparent. "Let me only give it a good scouring and a good bath," he said to himself, "and yellow fever and other diseases will disappear." He set to work with an energy and a completeness that soon brought unique fame to his name. Almost magical results were achieved, so that in a few months Havana had been transformed into a city which was said to be as orderly, as clean, and as civilized in appearance as Fifth Avenue itself. As the result of these measures the general death-rate of the city immediately declined; such diseases as typhoid and dysentery all but disappeared. As regards yellow fever, however, the disease at which they were chiefly aiming, they produced not the slightest effect. Here, then, was proof enough of the incorrectness of the prevailing theory that yellow fever was a "filth disease," and some other hypothesis must be found. The transmission of disease by insects was now beginning to attract attention. Indeed, as long ago as 1881 Dr. Carlos Finley, a physician practising in Havana, had proclaimed that yellow fever was transmitted by the *Stegomyia* mosquito, but had never been able to substantiate his thesis. Even before this Sir Patrick Manson, in 1880, had discovered the transmission of filariasis by mosquitoes, and in 1887 Theobald Smith and Kilborne had proved that Texas fever in cattle was transmitted by a tick, whilst in 1897 Sir Ronald Ross had demonstrated that the infecting agent in malaria was the *Anopheles* mosquito. Then came Dr. R. H. Carter's

[1] "William Crawford Gorgas—His Life and Work." By Marie D. Gorgas and Burton J. Hendrick. Lea and Fibiger, Philadelphia and New York. Price 5 dollars.

observations on the spread of yellow fever with the time relationship between exposure to infection and contracting the disease, which suggested an "extrinsic incubation." The paper embodying these vitally important observations of Dr. Carter was refused by a medical journal as too long. Reed, however, who was conversant with Manson's and Ross's work on mosquitoes, gave them most painstaking study. "Are you sure your dates are accurate," he asked Carter, who replied that he had no doubt on that point. "Then," said Reed, "it spells an insect host." With these ideas in his mind Reed joined the Yellow Fever Commission of 1900 and 1901, his fellow commissioners being Lazeau, Carrol and Agramonte. Guided by the genius of Reed this commission definitely solved the problem and proved beyond any shadow of doubt the part played by the *Stegomyia* mosquito in the transmission of yellow fever. Unfortunately, this work cost Lazeau his life and Carrol a severe attack of the disease. Gorgas was quick to grasp the significance of these results. "If it is the mosquito," said Gorgas, when the Reed experiments were on the way, "I am going to get rid of the mosquito." And get rid of them he did, notwithstanding that mosquitoes abounded in countless billions and Havana and its environs were so full of them that they filled every alleyway, every street, every house, and every nook and cranny of the city, and even at times settled over the community like a cloud. The fact that the *Stegomyia* was a house mosquito, however, enormously helped the anti-mosquito campaign. Gorgas began his anti-mosquito campaign in March, 1901, and the results were startling. For 140 years prior to this, Havana had not been free from yellow fever for a single day, whereas subsequently only five cases occurred, and these in the July and August of the same year. It is true that there was another outbreak in 1905, but this was promptly checked by the application of Gorgas's methods. Since then eighteen years have passed without a single case having occurred. He next turned his attention to the Panama Canal zone, where epidemics of insect-borne diseases—yellow fever and malaria—had defeated de Lesseps and the French in their attempt to build the canal. Gorgas introduced his methods into the canal zone and instituted a vigorous anti-mosquito campaign on the same lines as that which had been so successful in Havana, although he had to fight much official interference and obstruction in doing so. Yellow fever was banished from Panama and the building of the canal was brought to a successful issue.

Since then the methods of Gorgas have been followed wherever yellow fever existed, notably in New Orleans and in Rio de Janeiro and other parts of tropical America, with such success that yellow fever has almost entirely been abolished from the surface of the globe. Honours fell thick and fast on to Gorgas for the part he had played in the eradication of yellow fever, not the least important being the presentation of the Insignia of a Knight Commander of the Most Distinguished Order of St. Michael and St. George, by King George in person, as Gorgas lay dying in the Queen Alexandra Military Hospital, London, whilst on a visit to England in 1920.

"Hail, Router of the Plague of flies! Hail, Isthmian Conqueror true!
Gorgas, to that wise Goddess dear, the Gorgon death who slew!"

S. E. T.

Annotations.

Sugar-content of the Blood in Runners following a Marathon Race, with Special Reference to the Prevention of Hypoglycemia (Burgess Gordon, M.D., L. A. Kohn, M.D., S. A. Levine, M.D., Marcel Matton, M.D., W. de M. Scriver, M.D., and W. B. Whiting, M.D., *Journal of the American Medical Association*, August 15, 1925).—Marathon runners who completed the race of 1924 and showed blood-sugar levels below normal mere placed on a moderately high carbohydrate diet during this year's training season. In addition, they were advised to take a large amount of carbohydrate twenty-four hours before the race. Another group of runners who developed symptoms of weakness and hunger in the 1924 race were studied during this year's training season with the purpose of determining, if possible, at what stage in a 25-mile run the symptoms of hunger and weakness were likely to develop. It was found that this was apt to occur between the fourteenth and eighteenth miles. Therefore, in addition to being advised to eat moderately large amounts of carbohydrates before the race, these athletes were supplied with glucose candies to be eaten from time to time while running. In addition, they were supplied with tea containing a large amount of sugar at stations along the course. The blood-studies showed normal sugar levels in all runners, in contrast to the low figures obtained last year. There was also a striking improvement in their general physical condition. In a number of instances the running time was faster than that in the year previous and the participants finished in better condition. It seems, therefore, that the picture of exhaustion, weakness, shock and other symptoms of hypoglycemia following prolonged effort may be prevented by the adequate and timely ingestion of carbohydrate.

Plague Fleas, with Special Reference to the Milroy Lectures, 1924 (L. Fabian Hirst, M.D., D.P.H., *Journal of Hygiene*, July, 1925).—The geographical distribution of the different species of rat-flea is one of the most important factors governing the spread of plague. *Xenopsylla cheopis* is the most effective transmitter of both epidemic and epizootic bubonic plague in all parts of the world. The relative immunity of certain parts of India and Ceylon from plague is to be primarily

attributed to the prevalence of an inefficient plague-carrying flea on the rats of these localities, viz., *X. astia*. Climatic conditions play only a secondary part in limiting the spread of the disease in these relatively plague-free localities. Plague infection can be maintained in such localities by the importation of *cheopis*-infected merchandise. Climate does not exert an equal effect upon the transmitting power of different species of flea. Numerous attempts to transmit plague from rat to rat by means of *X. astia* at room temperature during the plague season at Colombo have all failed. *X. astia*, however, can carry plague from rat to rat under climatic conditions favourable to plague transmission. Continuous transmission of plague from rat to rat has been obtained with *X. cheopis* in Colombo under exceptionally unfavourable climatic conditions. Both plague and *X. cheopis* have a very irregular distribution within limits of Colombo City. The co-efficient of correlation between two periods of human plague incidence and percentage of *cheopis* to total rat-fleas of all species in fourteen districts of the city is 0·95, probable error 0·02, for both periods. There is a close relation between premises infested with *X. cheopis* and premises where plague-infected rats are found. A threefold relationship exists between the amount of imported grain, the prevalence of *cheopis* on rats, and the incidence of plague in the localities where grain is stored in Colombo. The measures so far devised for combating plague among Oriental populations, tolerant of all forms of animal life, have not proved conspicuously successful. Due recognition of the importance of the flea species factor should lead to marked improvement in plague preventive measures in many parts of the world. A rat-flea survey of all the principal plague areas, especially the ports, becomes urgently necessary. The exports from localities where *X. cheopis* is found to be prevalent upon the rats should be considered actively dangerous when the locality is plague-infected, and potentially dangerous even if it is plague-free, since the continual importation of *cheopis* into a locality where this flea is not indigenous may eventually result in the extension of plague infection to a new area. It is agreed that the export of produce, especially grain, from plague-infected ports should be controlled by international agreement. The limitation of imported *cheopis* and plague to definite zones in such localities as Colombo greatly facilitates the task of plague prevention, since all available resources can be concentrated simultaneously, or successively, on the infected areas. In such instances it is possible to mark out the potentially plague-infected zones by the simple and accurate method of surveying the rat-fleas.

Specificity of the Sero-reaction in Experimental Syphilis with Special Reference to the "Sachs-Georgi" Reaction (Satoshi Takenaka, *Acta Dermatologica*, January, 1925).—Comparative experiments with human serum indicate that although the Sachs-Georgi reaction and the Wassermann reaction are not in absolute agreement in all cases, they are in accord with each other in the great majority of cases (93·2 per cent.). When they disagree the Sachs-Georgi reaction is oftener in agreement with the clinical features. In the cases of rabbit syphilis, it was shown as the result of comparative studies made systematically that the two reactions, although they disagree in parts similar to the cases of the human sera, are of similar type as regards the entire course of the appearance, continuation and disappearance of the positive reaction, and, therefore, there are no fundamental differences between them, except that the Sachs-Georgi reaction is considered to some extent more sensitive than the Wassermann reaction. The results with human sera and those of the systematic comparative studies of experimental syphilis indicate that, if circumstances permit, it is better to employ the two reactions simultaneously, but in cases where the execution of the Wassermann test is not practical it is considered fully justifiable to substitute the Sachs-Georgi reaction for the Wassermann reaction. Care must be used, however, since the choice of the antigen is more important in the Sachs-Georgi reaction than in the Wassermann reaction, to employ only an antigen prepared and certified at some fully equipped laboratory.

A Comparative Study of Clonorchis Sinensis (Cobbold) (Dr. Ch'en Pang, *Transactions of the Fifth Congress of the Far Eastern Association of Tropical Medicine*).—*C. sinensis* is the common parasite of man and domestic mammals, especially the cat and dog. It is found less frequently in the liver of the marten, the wild cat, the badger, and perhaps other host species not yet investigated. The size of *C. sinensis* is relatively variable even in one host. On the other hand, the eggs have a uniformly constant size. Although there are different sizes of worms, there are no indications of specific differences in the internal anatomy of the specimens examined. The liver distome which the author examined belonged to one species, *C. sinensis* (Cobbold).

Radiotherapy in the Treatment of Tuberculous Cervical Adenitis (Morris K. Smith, M.D., and J. Gardner Hopkins, M.D., *Journal of the American Medical Association*, July 25, 1925).—The object of the study of the cases described in this paper was to estimate the value of Roentgen-ray therapy with excision in the treatment of tuberculous adenitis. Surgical experience, as expressed in such reports as that of Dowd, has shown that in early cases with a localized mass of involved nodes excision gives a high percentage of cures. In such cases, permanent cure by the Roentgen-ray is frequently possible, but seems less certain. The possibility that large firm nodes will break down under Roentgen-ray treatment must be considered. In choosing the method of treatment for such an individual case, the uncertainty and tediousness of radiotherapy must be weighed against the operative risk

and resultant scar after surgical procedure. There are, however, other cases in which complete excision is impractical or impossible, many of which can be definitely cured by the Roentgen-ray. It is not always a question of choice between surgery and radiotherapy, as incision and aspiration are surgical procedures indispensable to success in many cases in which the Roentgen-ray is used. The author is convinced that both surgery and Roentgen-ray therapy have important places in the treatment of tuberculous adenitis.

Treatment with Intraperitoneal Injection of Neo-arsphenamin (Heyworth N. Sanford, M.D., *Journal of the American Medical Association*, July 25, 1925).—From the results of experiments on animals and the clinical data obtained from ten cases, it is judged that neo-arsphenamin can be given intraperitoneally to infants with safety. Although this method is not as rapid as the intravenous injections, the neo-arsphenamin is absorbed with sufficient rapidity to act in any condition. This method is ideal for use in children in whom the small veins make the injection difficult, and the condition is of such degree that active treatment is imperative.

Tuberculosis of the Vagina (Lawrence R. Wharton, M.D., *Journal of the American Medical Association*, July 25, 1925).—Tuberculosis of the vagina is one of the rarest of all gynæcologic diseases. It almost never occurs as the primary manifestation of the disease; at necropsy, in practically every instance older tuberculous lesions have been found elsewhere. The vaginal lesion is not always secondary to tuberculosis of the uterus or Fallopian tubes; in fourteen of twenty-eight cases examined at necropsy the uterus, tubes and ovaries were normal. The treatment and prognosis depend on the activity and extent of the associated tuberculous lesions. Tuberculous ulcers of the vagina rarely yield to conservative treatment, excision is the procedure of choice. In every instance, however, the therapeutic problem is fundamentally medical, and the patient should be treated from that point of view.

Beriberi from a Diet of Raw Starch (*The Journal of the American Medical Association*, August 8, 1925).—The diagnosis of beriberi in the patient described in this paper seems justified because of (1) the history of a prolonged high carbohydrate diet deficient in vitamins; (2) the clinical picture of peripheral neuritis with myocardial failure—the ordinary causes for these conditions having been eliminated, and (3) the rapid response which the patient made to specific therapy. The nephritis is difficult to explain. Beriberi ordinarily does not produce a nephritis. Whether it occurred as an independent condition or as the result of intravenous medication, it is impossible to say. The possibility of some toxic substance in the starch itself, which could produce both a nephritis and a peripheral neuritis, was carefully considered. However, the analysis of gloss starch given in the textbooks, as well as that submitted by the manufacturers of the particular starch in question, makes this possibility very unlikely. The peculiar cardiac findings simulating aortic valve disease afford material for much interesting speculation. Vedder has shown that beriberi is a disease of the entire nervous system, and it seems possible that a paralysis of the vasomotor system, in which the heart was pumping blood into relaxed and dilated arterioles, could give the vascular signs presented by the patient. On the other hand, a relative aortic insufficiency might have occurred as a result of the dilatation of the heart, although if this were true it seems as though a diastolic murmur should have been present.

Meralgia Paræsthetica: Relation to Osteoarthritis of Spinal Vertebræ (*Journal of the American Medical Association*, August 8, 1925).—In the light of the facts given in this paper, the conception that meralgia paræsthetica is a peripheral nerve disease due to trauma, infections, static foot disturbances, or other vague disturbances must be abandoned. A study of twenty-five cases revealed the fact that this affection is radicular in nature and the result of the irritation or compression in the intervertebral spaces or foramina. That this irritation or compression can be attributed to an osteoarthritic process in the vertebræ was confirmed by clinical and Roentgen-ray evidence. Whilst the matter of treatment has not been under consideration, it obviously suggests itself as directing therapeutic efforts toward the cause and not the effects of the affection.

Hexyl Resorcinol. The Development and Clinical Application of a Synthetic Compound Possessing the Experimental Requirements of an Ideal Internal Urinary Antiseptic (Veader Leonard, *Journal of Urology*, December 6, 1924).—Hexylresorcinol, a stable organic substance of known chemical constitution, is the most powerful germicide ever described as a non-toxic substance. As measured by the Hygienic Laboratory method now in use it exhibits an increase in bactericidal power over resorcinol, its mother substance, of more than 15,000 per cent., and over phenol of more than 4,000 per cent. The application of hexyl resorcinol as an internal urinary antiseptic is based upon a logical and orderly development of the chemical and biological characteristics of its lower homologues. Hexyl resorcinol is non-toxic by mouth and its prolonged administration of large repeated doses to animals and to man results in no injury to the kidney or irritation of the urinary tract. It retains its powerful bactericidal action in solution in human urine of any reaction, and is secreted unchanged by the kidney after oral administration in sufficient concentration to impart active bactericidal properties to the urine. No other substance (except its less efficient homologue) has ever been described as possessing these qualifications. The enormous

excess of bactericidal power in hexyl resorcinol is necessary to an internal urinary antiseptic of this type because the bulk of each dose is excreted as an inert conjugate. Otherwise a few milligrams a day, instead of 0·3 to 0·6 grm. three times a day, would be sufficient to insure a practically continuous flow of bactericidal urine. It is highly probable that hexyl resorcinol exerts little, if any, influence on infections which have invaded the parenchyma of the kidney. It is an internal urinary antiseptic. No internal renal antiseptic is known. Urinary infections due to *B. coli* and confined to the urinary mucosa from the kidney pelvis downward can be cleared up completely with no other treatment than hexyl resorcinol by mouth if the bacterial count of the urine is low. If the count is high, as is usually the case in *B. coli* infections, the mass action of the free hexyl resorcinol, excreted in the urine, is insufficient to complete the disinfection until the count is reduced by local treatment. Persistent treatment (thirty to sixty days) is usually necessary in these cases. If the infection has invaded the renal parenchyma, as is usual in cases of long standing, hexyl resorcinol, alone or combined with any known method of treatment, will not complete the disinfection and frequently fails even to influence it. In some of these heavy *B. coli* infections there is, however, very pronounced clinical improvement as evidenced by subsidence of symptoms, macroscopic clearing of the urine, gain in weight, &c., without any apparent reduction in the number of organisms per cubic centimetre of urine. Urinary infections due to the usual Gram-positive cocci ordinarily clear up promptly, completely and permanently with no other treatment than hexyl resorcinol by mouth.

The Use of Fish in the Control of Yellow Fever in Peru (Major Henry Hanson and Lawrence H. Dunn, *Military Surgeon*, September, 1925).—Fish were used in many of the early yellow fever campaigns for the destruction of *Ædes ægypti* larvæ, but nowhere so extensively as in Guayaquil. They were tried and found very efficacious in Peru in 1921, where they were used on the most extensive scale yet employed, and with the most strikingly good results. The early control methods in Peru consisted in throwing out water that contained larvæ; covering containers; limiting the number of containers and requiring an alternation in their use, so that from time to time each receptacle could be turned upside down and allowed to dry; and finally straining once every week or ten days all the water kept in containers. The prevailing types of container were tanks, barrels, botijas and tinajas, with the botijas and tinajas predominating. Experiments with fish were begun early in the year 1921 in Chiclayo, where six local species of fish were tried out for their larvicidal properties and adaptability for use as an anti-*ægypti* measure. Of the six species, two were found to be very satisfactory, the *chaloquoques* and *lifes*, the latter being the best, most readily available, and generally used. Wherever these were distributed in containers the breeding index promptly fell to well below the index of safety against the spread of yellow fever. Nearly a million of them were used.

Current Literature.

INDIAN MEDICAL JOURNAL.
September, 1925.

Notes on Some Methods for Diagnosis of Hookworm Infection and for Estimating the Egg Output (Asa C. Chandler).—The author compares the Kofoid and Barber method of salt flotation and surface looping with Lane's method of direct centrifugal flotation (D.C.F.) for diagnosis of hookworm infection, and considers the former of greater value than the latter. With regard to egg output the following may be quoted: "The substitution of the D.C.F. method for the Stoll egg-counting method for estimating egg output seems to us quite impracticable. Even assuming that with every detail of the technique carefully controlled, 90 per cent. or more of the total eggs can be obtained on a single spin, when this number exceeds one or two hundred, which is more frequently the case than otherwise, the counting of the eggs is very burdensome; and when the eggs exceed five or six hundred an accurate account becomes quite impossible without spreading the drop over a large area or washing the eggs into a measured quantity of fluid and counting the number in a measured fraction, either of which involves time and labour. The results from our egg-counting technique indicate that it is as fully as accurate as the D.C.F. method—even when the latter is pushed to finality—and it is certainly less troublesome in that a single process is suitable for all degrees of infection. Where less than 100 eggs per grm. are present only one or no eggs can be expected on two slides. If there is one egg on two slides an average of fifty is indicated, whereas two negative slides from a stool which has been shown to be positive by a concentrative technique can arbitrarily be regarded as having twenty-five eggs per grm. without involving any great inaccuracy in a group estimate.

The Toxicity of Carbon Tetrachloride to Cats. A Warning (Asa C. Chandler and R. N. Chopra).—From these experiments one can conclude that it is very unsafe to treat feline animals with carbon tetrachloride. These results differ widely from those obtained in 1923 by Hall and Shillinger, who reported ten experiments on five kittens with doses of carbon tetrachloride, and who state that carbon tetrachloride at the rate of 0·3 c.c. per kilo is well tolerated by cats. The authors, in giving carbon tetrachloride to 87 cats, in various doses and under various conditions of diet, &c., found the susceptibility of cats to this drug very great.

Observations on Dementia Præcox (Frank Noronha).—A recognition of the early symptoms of this disease is of importance to the general prac-

titioner, and if the case is taken in hand early there is prospect of rehabilitating the patient and preventing permanent mental breakdown. In the majority of cases there is a history of the patient having run away from home, and in his travels having come in collision with the law and thereby being recognized as insane for the first time. This impulsive act, so characteristic of the disease, leads later on to other irregularities of conduct which finally land the afflicted person into the asylum. Within a few days, or sometimes within the twenty-four hours, of admission into the asylum he shows evidence of the true nature of his malady. A maniacal patient has a ready reason to account for his act, but it is not so with a præcox patient; he has no answer ready when questioned but a bare denial, with a purposeless smile. A point of interest to the general practitioner is that some of these cases in their incipient stages may be mistaken for hysteria or neurasthenia; and that dementia præcox may supervene on a previous hysterical or neurasthenic state. Occupation of a definite character and persuasion are of great help in the treatment of these patients. Although they may resist at first, they could be got round with persistent persuasion, and the effect of work is seen in the improvement in their physical condition and corresponding increase of mental stability.

Experiments in Air Embolism (A. R. D'Abreu).—The conclusions drawn from these experiments are as follows. A few small bubbles of air injected into a vein at a slow rate are apparently harmless, and a like remark would also appear to apply to a small continuous column of air. Twenty-four ounces of air was sufficient to produce the death of a bull weighing approximately 500 lb., so that a man weighing 10 to 11 stone would proportionately take about 6 to 7 oz. as the lethal dose. Rabbits succumb very easily to air embolism, but they are somewhat delicate and susceptible rodents, and human beings might be similarly qualified as their endurance can hardly be compared with that of beasts of the field on whom the experiments were tried. Hence the lethal dose would in reality probably be less than 6 or 7 oz. On the other hand, the velocity of the circulation and pulse-rate (45 per minute) in oxen are both slower than in man, and the specific gravity of their blood, which is 1,060, or slightly more, is higher than in man, the three being qualities likely to give a greater susceptibility to the effects of air emboli, although their endurance may be greater than man's. The first noticeable symptoms were produced when 8 oz. of air was injected. Assuming this quantity to be the dangerous limit for animals used, then working it out proportionately, a volume of 2 oz and 2 dr. is considered unsafe for man.

Blood of a thicker consistency, i.e. of a higher specific gravity than the normal of 1.056, must flow through the vessels with difficulty and be more prone to clot around air globules. If, therefore, in disease the specific gravity of the blood goes up with a retardation of the flow, then the admission of air into the veins should be carefully guarded against. In those diseases in which the coagulability of the blood is increased these precautions should also be taken. When severe hæmorrhages have taken place the blood coagulates quicker than normally, and in these cases also the entry of air during intravenous transfusions should be especially excluded. In such cases, before any quantity of fluid has been transfused, a large air embolus entering the feebly acting right heart would be likely to further embarrass its action, causing clotting and death, which might easily be put down to the original progressing collapse. In anticipation of these accidents with air emboli of large size some antidote in the form of an injection for immediate use, to reduce the coagulability of the blood suggests itself.

Treatment of Some Abdominal Conditions with Inflation of Oxygen Gas (R. S. Grewal).—The treatment of abdominal conditions with inflation of oxygen gas has been used with great success at the Civil Hospital, Maymyo, during the past few months. The advantages of the operation are: It can be done in subjects who have lung complications and also when the use of chloroform is not safe. Very few instruments are required. There is no danger. It can be done even in small hospitals. Results are good.

Action of Disinfectants on Microbes: An Interesting Phenomenon (H. Gosh).—During the course of experiments to find out whether by increasing the time of contact of bacteria and disinfectants the rate and extent of growth of the former declined or increased, it was found that certain bacteria showed some growth after one hour of contact with a disinfectant, but produced no growth after three to five hours of contact. After twenty-four or forty-eight hours of contact, however, a few colonies appeared at first, but gradually the number increased as the time of contact was increased. The technique followed is described and three charts accompany the paper.

"Stibosan" (Von Heyden "471") in Private Practice (Sudhir Kumar Das).—The author has used "471" in the treatment of kala-azar and considers it much better in its effects than all the other antimony compounds on the market. It checks the fever with great rapidity; in the cases reported, the average number of injections required to check the fever was three. The duration of the treatment is very short and the patient is, therefore, invalided for a short period only. There is rapid reduction in the size of the spleen. The spleen at first becomes thinned out, then diminishes in size, and from the fifth injection reduces rapidly. No untoward effects have been noted. No vomiting occurred after injection, and no pulmonary complications occurred. In one case the patient had been suffering from piles, heart trouble (a systolic bruit in the mitral area), and was anæmic. After three injections the bruit disappeared and the piles were cured when the injections were completed. The only drawback of this drug is its price; it is too expensive for the poor, and it is amongst the poorer classes that the disease is commonest.

Original Communications.

SOME OBSERVATIONS AND EXPERIMENTS ON *GONGYLONEMA* IN NORTHERN ITALY. A PRELIMINARY NOTE.

By H. A. Baylis, M.A., D.Sc., T. C. Pan, M.B., Ch.B., and Juliet E. B. Sambon.

A number of insects collected by one of us (H.A.B.) and by Dr. L. W. Sambon on an expedition to the Trentino in the autumn of 1924, and numerous others collected in the same region during the present summer (July-September, 1925) have been dissected with a view to discovering the intermediate hosts of *Gongylonema* in Northern Italy. Altogether more than 1,300 insects have been carefully examined. Of these nearly 900 were what may be called "household insects"—i.e., cockroaches, meal-worm beetles, cellar-beetles and other forms that inhabit human dwelling-houses or the stables, cow-sheds and fowl-houses in immediate proximity to them. In none of these were we able to demonstrate the existence of larvæ of *Gongylonema*, although the larvæ of certain other Nematode and Cestode worms were occasionally found in them. The following table shows the numbers and localities of the more important kinds of household insects studied.

Table I.—Household Insects.

	Villa Lagarina	San Michele	Lavis	Coredo	Mezzana	Calavino	Vigo di Fassa	Valda	Castello	Grumes	Lases	Canezza	Castiglione di Cervia
Blatta orientalis	222	—	4	—	—	—	2	—	—	—	—	—	—
Blattella germanica	—	9	3	10	32	12	6	51	50	164	—	—	—
Tenebrio molitor (imago and larva)	2	—	—	—	—	—	—	51	—	—	—	—	—
Tenebrio obscurus (imago and larva)	59	—	54	—	—	—	—	—	—	—	—	--	—
Blaps lethifera (imago and larva)	34	—	29	—	—	—	—	20	—	—	15	3	31

In addition to the species mentioned in the table, a few specimens of other insects, such as the larvæ of meal-moths (*Ephestia*) and of *Dermestes*, were also dissected, with equally negative results.

A large proportion of our work was centred in the village of Villa Lagarina, which lies in the Valley of the Adige near Rovereto. As it was found that practically all the local cattle slaughtered in this district were infected with *Gongylonema*[1], and as the larvæ of the cattle form of *Gongylonema* had been found in America by Ransom and Hall (1915) in certain dung-beetles of the genera *Aphodius* and *Onthophagus*, we next turned our attention to these insects.

[1] While common in the lower valley of the Adige, *Gongylonema* infection of cattle appears to be rare or absent in the region of the Upper Adige and in the valleys of La Pusteria.

Having found certain spots to which the cattle of Villa Lagarina were taken to graze, we collected as many dung-beetles as possible from the fresh cow-dung in these places. The beetles were all identified by Mr. K. G. Blair, of the British Museum (Natural History). The most abundant species was *Onthophagus taurus*, and next to it in numbers was *Caccobius schreberi*. Of the beetles collected in this locality 450 were dissected, and in a certain percentage of them encysted larvæ corresponding to those of *Gongylonema* were found. The following table (Table II) gives the number of each species dissected, and the number found positive for *Gongylonema* larvæ.

Table II.—Dung-Beetles.

	Total examined	Positive for Gongylonema
Onthophagus taurus L.	200	7
Onthophagus furcatus F.	22	—
Onthophagus opacicollis Reitt.	12	—
Caccobius schreberi L.	55	2
Aphodius fimetarius L.	21	—
Aphodius hæmorrhoidalis L.	37	1
Aphodius subterraneus L.	63	—
Gymnopleurus sturmi Macleay	22	—
Oniticellus fulvus Goeze	45	2
Sphæridium bipustulatum F.	36	—
Histeridæ (3 species)	13	—

So far as can be judged from the small figures available, it appears that between 3½ and 5 per cent. of certain species of dung-beetles (*Onthophagus taurus*, *Caccobius schreberi*, *Aphodius hæmorrhoidalis*, *Oniticellus fulvus*) in this locality are infected with *Gongylonema*. In all probability both the incidence of infection and the number of species infected are higher. The larvæ may have been frequently overlooked owing to their small size and the difficulty of examining every part of the beetles; while the number of specimens dissected is, in many cases, regrettably small.

The dung-beetles mentioned are the only insects which may certainly be regarded as intermediate hosts of *Gongylonema* in this part of Italy. They occur, not in the houses, stables, or cow-sheds, but in the open. Our specimens, as has been mentioned, were all collected from cow-dung. No other animals besides cattle appeared to have grazed in the places where they were collected, and since a high percentage of the local cattle is infected

with *Gongylonema*, there is a strong presumption that the larvæ found belonged to the cattle form of *Gongylonema*.

So far as we are aware, no information exists as to the intermediate hosts of the cattle *Gongylonema* in Europe, and we believe that this is the first occasion on which systematic search has been made for them. In the United States of America the following dung-beetles are known to serve as intermediate hosts (Ransom and Hall, 1915): *Aphodius femoralis*, *A. granarius*, *A. fimetarius*, *A. coloradensis*, *A. vittatus*, *Onthophagus hecate* and *O. pennsylvanicus*. It is not quite clear from Ransom and Hall's paper whether *Aphodius congregatus* and *A. inquinatus* were definitely found to be infected. In Algeria, Seurat (1916) has recorded the finding of larvæ which he attributes to *Gongylonema scutatum* in *Blaps appendiculata*, *B. strauchi* and another species of *Blaps*. Ransom and Hall (1917),

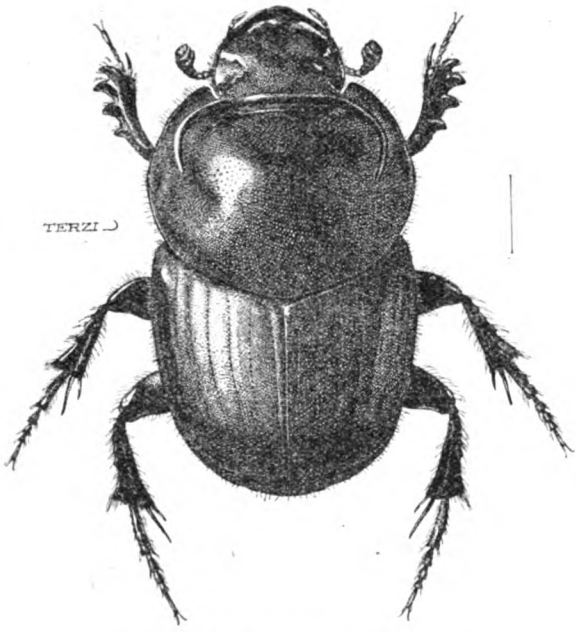


FIG. 1.—*Onthophagus taurus*. ♂.

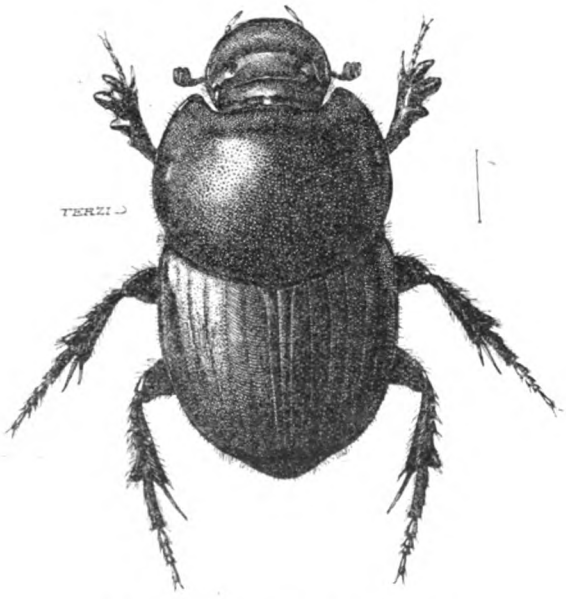


FIG. 2.—*Onthophagus taurus*. ♀.

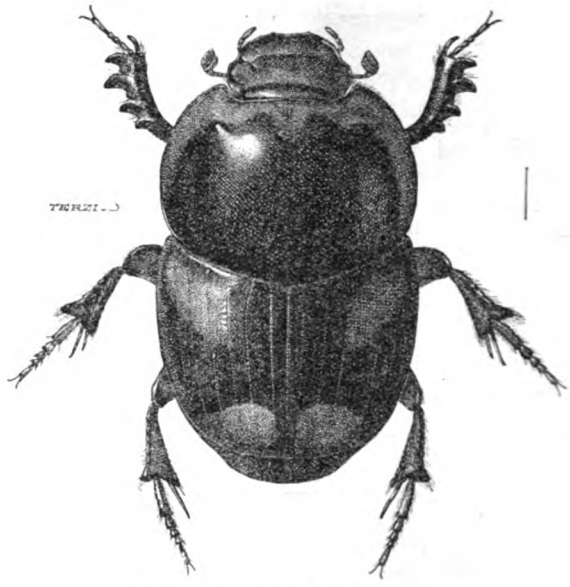


FIG. 3.—*Caccobius schreberi*.

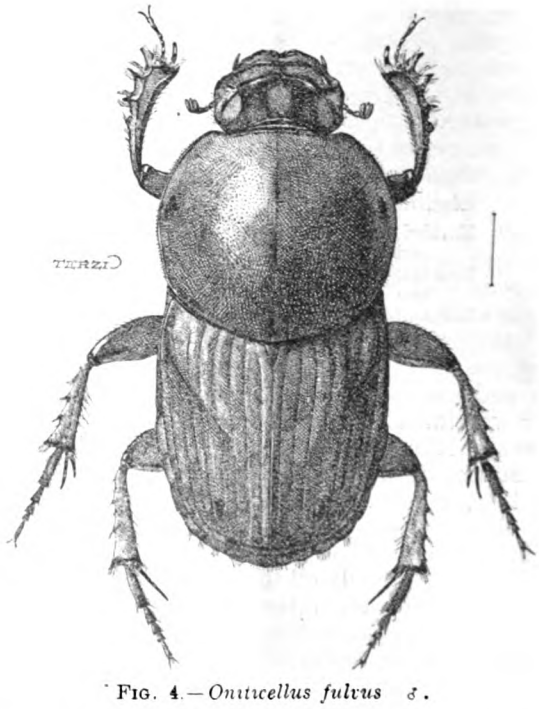


FIG. 4.—*Oniticellus fulvus* ♂.

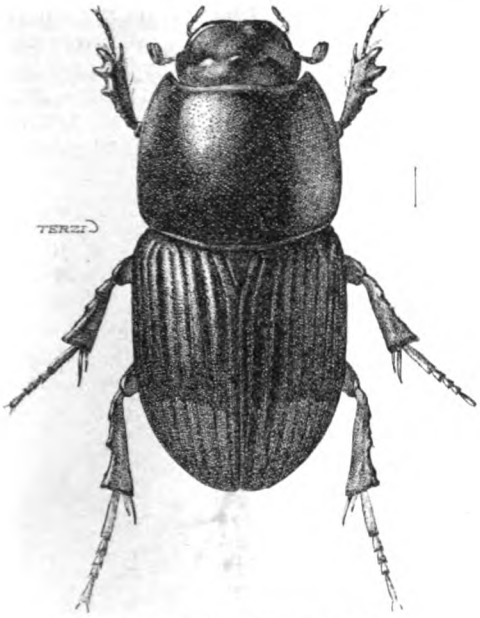


FIG. 5.—*Aphodius hæmorrhoidalis.*



FIG. 6.—Photomicrograph of an encapsuled larva (third stage) of *Gongylonema* from *Onthophagus taurus.* (× 70.) The capsule is in intimate connection with branches of the host's tracheæ and portions of the fat-body.

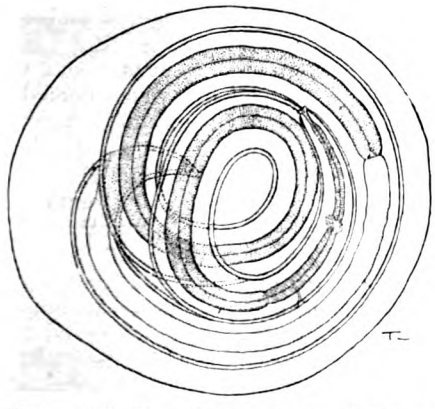


FIG. 7.—Encapsuled *Gongylonema* larva (third stage) from *Onthophagus taurus.* (× about 100.)

however, doubt the correctness of the specific determination of Seurat's larvæ, and are of the opinion that they did not belong to *G. scutatum* but to some other species. The constant absence of *Gongylonema* larvæ from the *Blaps* dissected by us in Italy supports this contention.

On the other hand, Seurat has recorded the occurrence in various Algerian dung-beetles (*Ateuchus sacer, Onitis irroratus, Onthophagus bedeli, Geotrupes douei, Gymnopleurus mopsus* and *G. sturmi*) of larvæ which he considers to be those of *Gongylonema mucronatum* Seurat, 1916, of the hedgehog. Ransom and Hall suggest that these may in reality have been the larvæ of the cattle form, and on comparing Seurat's measurements of these larvæ with those given by Ransom and Hall for their American larvæ, this seems highly probable.

Experimental Infection of Cockroaches.

It is well known that the larvæ of *Gongylonema neoplasticum* of rodents occur naturally, in certain localities, in the large American cockroach, *Periplaneta americana,* and sometimes in the common *Blatta orientalis* (Fibiger and Ditlevsen (1914), Wassink (1916)). They have also been experimentally transmitted by Fibiger both to *Blatta orientalis* and to *Blattella germanica.* The larvæ of the cattle *Gongylonema* have been successfully transmitted by Ransom and Hall (1915, 1917) not only to *Aphodius,* but also to *Blattella germanica.* The latter insect was also infected by them by feeding with the eggs of *Gongylonema* from the pig.

No attempt appears to have been made hitherto to infect *Blatta orientalis* with the cattle form of *Gongylonema.* Experiments carried out by us in Italy appear to show that while the infection of *Blattella* with this worm is easily brought about, it is difficult, if not impossible, to produce it in *Blatta.* Several batches of *Blatta orientalis* were fed repeatedly with eggs of *Gongylonema* taken from the œsophagi of cattle or sheep. The female worms were cut into small pieces in tap-water, and crumbs of bread were soaked in the mixture thus obtained. The technique was thus similar to that of Ransom and Hall (1917), except that tap-water was used instead of physiological salt solution. On dissecting a number of these cockroaches, taken at random, at intervals of from two to five weeks after the first feeding, no larvæ of *Gongylonema* were found, either encapsuled or free, in any part of the insects. On examining the intestines of the cockroaches, or their fæces, from one to four days after feeding with eggs, it was not difficult to find both unaltered eggs and empty shells whose polar caps had come away completely or had, in rare cases, been perforated. Living larvæ were not observed.

The result of a similar experiment with *Blattella germanica* was quite different. Twenty of these insects were fed four times (August 2, 7, 12, 21) with eggs of the cattle *Gongylonema.* On the third day after the first feed five of them were found dead, but nothing of interest was discovered in them on dissection. On August 20 (eighteen days after the first feed, thirteen days after the second

feed and eight days after the third feed) one *Blattella* was killed and dissected. Several young *Gongylonema* larvæ, apparently at the second stage, but already encapsuled, were found in its abdominal cavity. On the following day (August 21) a fourth feed of eggs was given to the remaining cockroaches. On August 31 (twenty-nine days after the first feed and ten days after the last feed) another cockroach was killed and dissected. It was found to contain twenty-seven fully-developed third-stage *Gongylonema* larvæ.

Experimental Infection of Rats.

(1) As a measure for controlling the entirely negative results of the dissection of cockroaches from houses in Villa Lagarina, seven rats[1] were fed on *Blatta orientalis* from two of the houses from which the largest number had been dissected.

Two rats were fed with fifty of the insects on August 11 and with a similar number on August 14. Their fæces were examined at intervals both before and after the experimental feeding, but never showed any eggs of *Gongylonema*. On November 4 the two rats were killed and carefully dissected, not only the stomach, but the œsophagus and mouth being thoroughly examined, but no *Gongylonema* was found in them. Two more rats received two feeds of fifty *Blatta* from the same house on August 16 and 18 respectively, and were similarly negative when dissected on November 2. Three rats received a feed of forty-six *Blatta* from the second house on August 20, and were negative for *Gongylonema* when dissected on November 10.

(2) An attempt was made to infect three rats with the *Gongylonema* of cattle. The experiments were as follows:

(*a*) One rat received, on August 8, 10, 14 and 16, four feeds, each containing twenty-five *Onthophagus taurus* from the infected stock at Villa Lagarina. When killed and dissected on October 27 it showed no sign of infection with *Gongylonema*.

(*b*) Two other rats received *Gongylonema* larvæ, at the third or infective stage, isolated by dissection, as follows:

Rat A received a single larva from *Caccobius schreberi* on July 22. This was injected into its mouth with water by means of a pipette. On August 2 it received in the same way three larvæ from *Onthophagus taurus*. Rat B received, on August 17, four larvæ from *Caccobius schreberi*. On August 31 these two rats (which were kept together) received between them 16 larvæ from an experimentally-infected *Blattella germanica* (see previously described experiment). The larvæ, in this instance, were placed in water on two small square pieces of bread. This method did not, however, result, as was hoped, in an equal sharing

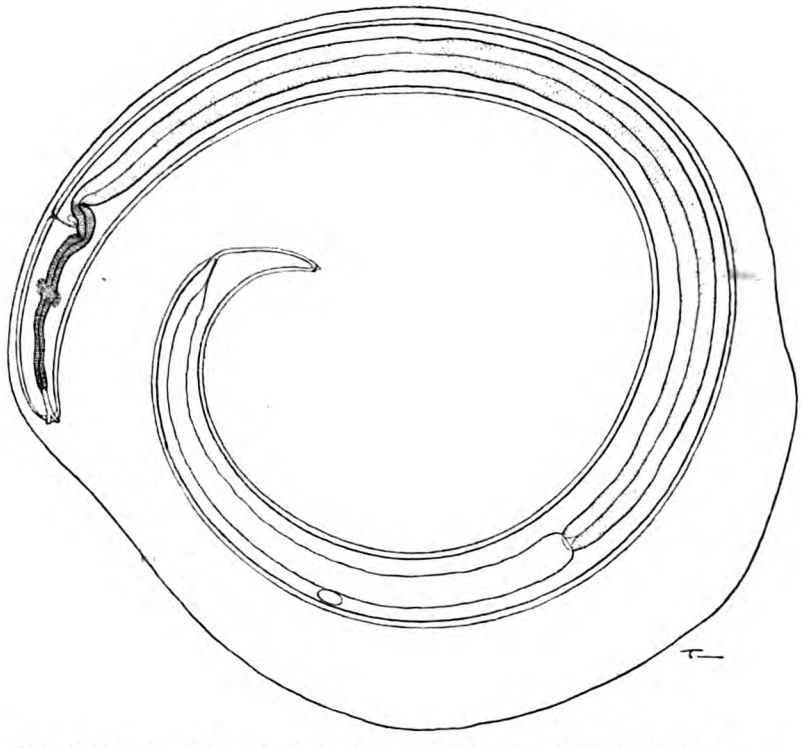


Fig. 8.—Encapsuled *Gongylonema* larva (third stage) from *Onthophagus taurus*. (× about 110.)

[1] The rats used in these experiments have been determined by Mr. M. A. C. Hinton as tame varieties of *Rattus norvegicus*.

of the meal, for rat B consumed nearly the whole of one piece and about half of the other, rat A, therefore, receiving very few, if any, of the larvæ. The fæces of both animals remained negative

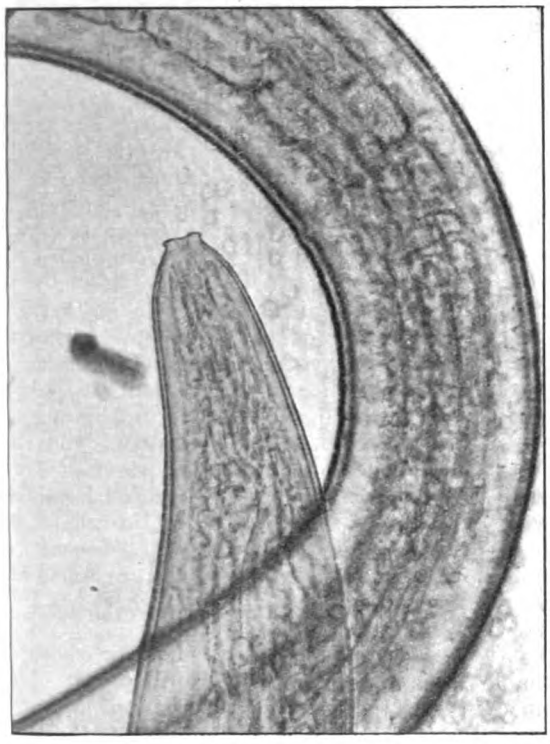


FIG. 9.—Photomicrograph of the head of a *Gongylonema* larva (third stage) from *Oniticellus fulvus*. (× 400.)

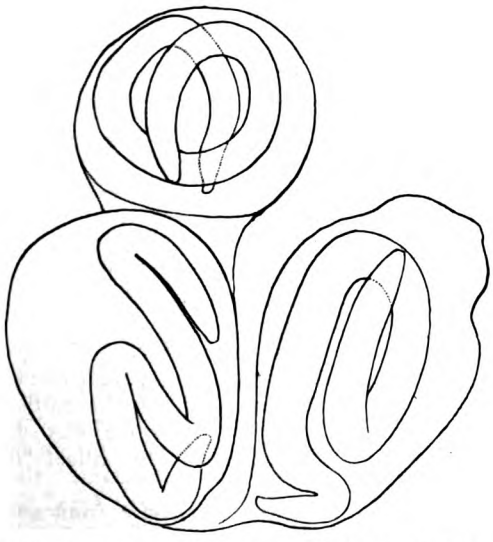


FIG. 10.—A group of three encapsuled second stage larvæ of the *Gongylonema* of cattle, from the body-cavity of an experimentally-infected *Blattella germanica*. (× about 100.)

for *Gongylonema* eggs, though examined repeatedly up to November 12. On November 16 (seventy-seven days after the last feeding) both rats were killed and dissected, and a single *Gongylonema* was found in the œsophagus of each. The stomach and mouth were, in each case, free from signs of infection. The worm in rat A was a male, which had a left spicule measuring 4·9 mm. in length. The worm in rat B was a small and apparently immature female.

Thus two out of three rats appear to have been successfully infected, though the infection was slight compared with the number of larvæ given

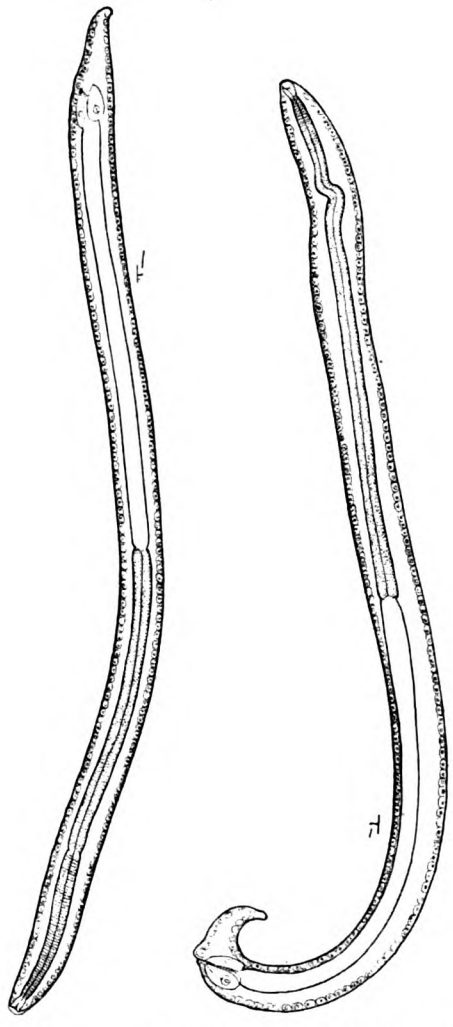


FIG 11.—Two second stage larvæ of the *Gongylonema* of cattle, from an experimentally-infected *Blattella*, removed from their capsules. (× about 110.)

to them. That the worms were actually derived from the larvæ experimentally administered, and that they belonged to the cattle form and not to the usual rat form of *Gongylonema* seems fairly certain from the following considerations. (1) Every reasonable precaution had been taken to guard against possible infection with the rat form, the rats used having been young animals specially taken out from England for the pur-

pose of these experiments, and having been kept in a place where they were not likely to come in contact with cockroaches or other insects.

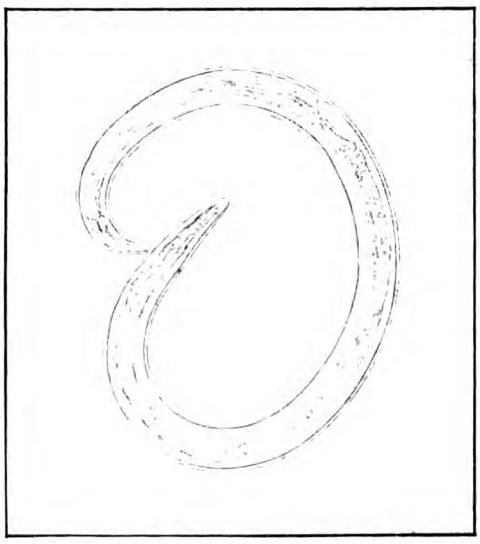
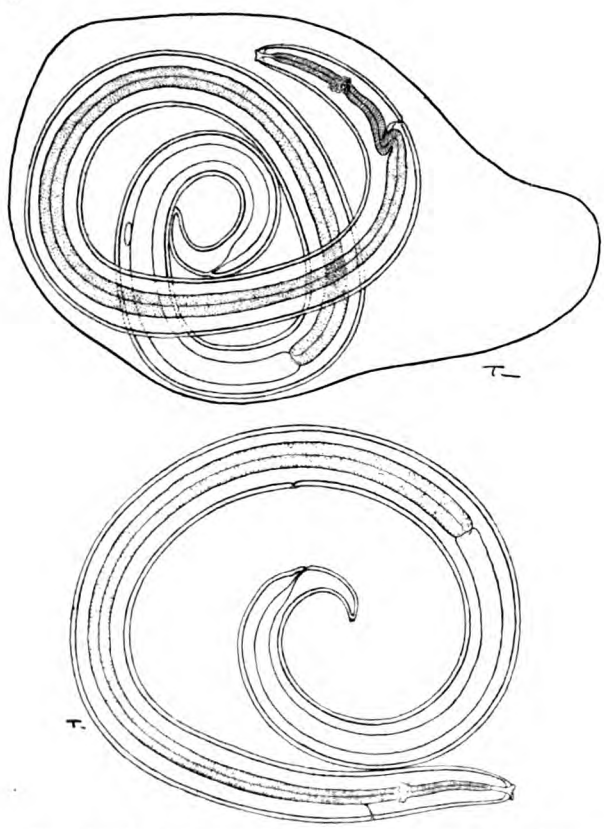


FIG. 12.—Photomicrograph of a third stage larva of the *Gongylonema* of cattle, from an experimentally-infected *Blattella*, removed from its capsule. (× 70.)



FIGS. 13 and 14.—Two third stage larvæ of the *Gongylonema* of cattle, from an experimentally-infected *Blattella*. (× about 100.) One larva is still enclosed in its capsule, the other has been liberated.

Further, their fæces had been examined repeatedly before the experiment. (2) Of a considerable number of wild rats obtained locally and dissected, none showed infection with *Gongylonema*. (3) None of the other rats kept near these two (all belonging to the same stock and being kept under the same conditions) showed any sign of infection either on fæcal examination or on dissection. (4) The worms were found in the œsophagus and not in the stomach, the latter being the more usual situation for the *Gongylonema* of rats. (5) The length of the left spicule of the male worm greatly exceeds the maximum hitherto recorded for *G. neoplasticum* (0·67 mm.), but is much more comparable with the minimum recorded for the *Gongylonema* of ruminants (5·0 mm.).

The experiment indicates, therefore, that it is possible for rodents to acquire infection with the form of *Gongylonema* considered by some authorities to be confined to ruminants. The only previous experiment known to us bearing on this question is one in which Ransom (see Ransom and Hall, 1915), on two occasions, fed a white mouse with *Gongylonema* larvæ apparently obtained from dung-beetles in the United States. The mouse was killed only twenty-eight days after the second feeding, and the fact that no worms were found in it may possibly have been due to the shortness of the time allowed for their development.

We take this opportunity of acknowledging the valuable assistance rendered, during part of the period, in the tedious work of dissection by Mr. K. G. Blair, B.Sc., F.E.S., and Mrs. C. Bonne.

We are also greatly indebted to Dr. A. L. Sheather for his excellent photomicrographs of some of our preparations, and to Mr. Terzi for the drawings which he has executed with his well-known skill and accuracy.

SUMMARY.

(1) Household insects, such as *Blatta*, *Blattella*, *Blaps*, *Tenebrio* and *Ephestia*, were not found to be naturally infected with *Gongylonema* in Northern Italy.

(2) Four species of dung-beetles (*Onthophagus taurus*, *Caccobius schreberi*, *Aphodius hæmorrhoidalis* and *Oniticellus fulvus*) were found to be naturally infected with larvæ of *Gongylonema*, presumably of the cattle form. No other natural intermediate hosts for *Gongylonema* were discovered.

(3) By feeding with the eggs of the cattle form of *Gongylonema*, *Blattella germanica* was successfully infected, but attempts to infect *Blatta orientalis* failed.

(4) Rats fed on *Blatta orientalis* from some of the houses concerned did not become infected with *Gongylonema*, thus confirming the negative results of dissection of the insects.

(5) Two rats were experimentally infected with the *Gongylonema* of ruminants by feeding them with larvæ obtained by dissection from the intermediate hosts.

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A NOTE ON THE FLAGELLATES OF ANOPHELINES AND CULICINES PREVIOUSLY MENTIONED IN THE LITERATURE WITH A DESCRIPTION OF A CRITHIDIAL FORM IN A NEW HOST *ANOPHELES UMBROSUS* FROM THE FEDERATED MALAY STATES.

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MATERIAL AND ACKNOWLEDGMENTS.

THE material, on which the description of the organism was based, was very kindly presented by Dr. H. P. Hacker, who, while making a field examination of female anophelines in the Federated Malay States for the presence of malarial oöcysts and sporozoites, found the flagellates in Giemsa-stained preparations of the gut contents of two female *Anopheles umbrosus*. A smear of the salivary gland of one of these mosquitoes also showed numerous flagellates.

An examination of the literature shows that these organisms are common in mosquitoes, and may possibly occur in most species. For example, flagellates have been reported in *Culex fatigans*, *Culex pipiens*, *Culex sylvestris*, *Culex triseriatus*, *Culex richardii*, *Anopheles paludis*, *Anopheles maculipennis*, *Anopheles stephensi*, *Theobaldia annulata*, *Anopheles nili*, *Anopheles superpictus* and *Stegomyia fasciata*. It is of interest, therefore, to report them in another host, viz., *Anopheles umbrosus*, but, while the forms seen and studied are crithidial flagellates capable of comparison morphologically with those described by other workers, it is unfortunately impossible, without further observations on the morphology and life-history, to correctly define their generic and specific identity.

THE GENERIC IDENTITY OF INSECT FLAGELLATES.

The common occurrence of flagellates belonging to the family Trypanosomidæ in blood-sucking and non-blood-sucking insects and arachnids all over the world is now well known, and is a factor of considerable importance in the investigation of the transmission of trypanosomiasis and leishmaniasis in man and animals. These insect flagellates may be placed in three groups: (1) Natural flagellates transmissible from insect to insect, which, as far as is known, are incapable of infecting man or animals. (2) Flagellates, which are the developmental stages of trypanosomes or leishmania, and are capable of infecting man and animals. (3) Flagellates whose habitat is the latex of certain plants, but which are also present in the gut of plant-sucking hemiptera.

Some confusion has arisen regarding the nomenclature of these flagellates, and new generic and specific names have been applied to them before their complete life-histories were known. Different specific names even have been given to organisms morphologically identical merely because they have occurred in separate hosts. Wenyon (1913) suggested a useful method of classifying generically these flagellates of insects, which is based both on the morphology and also on the life-history of the parasite. The adoption of this method would help to avoid confusion.

GENERIC CLASSIFICATION OF INSECT FLAGELLATES.

(1) Genus *Leptomonas*. Type *Leptomonas bütschlii* Kent, 1881.

The name was applied to a uniflagellate organism from *Trilobus gracilis* (a nematode). The body is trypaniform in shape, the nucleus more or less central, and the single flagellum arises in a blepharoplast near a parabasal body situated at the anterior extremity. There is never at any time in its history an undulating membrane. Ovoid leishmania-like bodies are formed, passed in the insect's fæces, and serve as the transmitting forms to other insects. As far as evidence is available these are true insect flagellates, and incapable of producing infection in vertebrates. The different species of *Leishmania* in man and animals produce in culture typical leptomonad forms.

The type species, *Leptomonas bütschlii*, has never been redescribed.

(2) Genus *Leishmania* Ross, 1903. Type *Leishmania donovani* Laveran and Mesnil, 1903.

In the vertebrate host these are ovoid bodies showing, in well-stained specimens, nucleus, parabasal body, blepharoplast and rhizoplast, but no free flagellum. In culture they develop into typical leptomonads, which undoubtedly represent a stage in the life-history in a transmitting insect. For this reason any leptomonad flagellate in an insect requires careful investigation.

(3) Genus *Crithidia* Leger, 1902, emend. Patton, 1908. Type *Crithidia fasciculata* Leger, 1902.

These are characterized by elongated bodies when fully developed. The nucleus is more or less central. Parabasal body and blepharoplast are situated close to the nucleus but anterior to it. The flagellum runs along the anterior margin of the body, form-

ing, in many cases, an undulating membrane. Trypanosome forms are never seen. These are common in insects, and the developmental forms of trypanosomes always show this type in the insect host. Many of them seem to be true insect parasites.

(4) Genus *Herpetomonas* Saville Kent, 1881. Type *Herpetomonas muscarum* (Leidy, 1856) Kent, 1881. (Syn. *Herpetomonas muscæ domesticæ*.)

This seems to be a true insect flagellate, and its developmental forms in the gut of the fly show leptomonad, crithidial, trypanosome and leishmania forms. These forms, encountered by different observers, have led to confusion, but the work of Rosenbuch (1910), Alexeiff (1911), Dunkerly (1911) and Wenyon (1913) has definitely established the fact that the various forms seen are merely stages of the development of a single genus, namely, *Herpetomonas*, which appears to be a true insect flagellate.

(5) Genus *Trypanosoma* Gruby, 1843. Type *Trypanosoma rotatorium* (Gruby) Mayer, 1843.

This is a parasite of animals. The body is elongated, nucleus more or less central and the parabasal body and the blepharoplast are posterior in position to the nucleus, and the flagellum runs along a well-defined undulating membrane. The developmental forms in the insect host may show leptomonad, crithidial, leishmania and trypanosome forms.

From the above classification one sees that it is impossible to assign a generic name to any of these flagellates before the complete morphology and life-history has been studied. A useful and striking example of the necessity for this careful study is well illustrated by the recent work of Hoare (1923) on *Trypanosoma melophagium*. For years numerous authorities regarded *Crithidia melophagia* Flu, 1908, as a natural flagellate of the sheep ked *Melophagus ovinus*. Hoare, however, showed that not only did crithidial forms occur in the ked's gut, but also leptomonads, leishmania forms and metacyclic trypanosomes. He further proved that clean sheep could be infected with a trypanosome by crushing infected keds in their mouths, and thus established the fact that the well-known crithidial forms were simply developmental stages of the genus *Trypanosoma*.

Specific Identity of Insect Flagellates.

In fixing the specific identity of a flagellate the morphology is certainly of great assistance, but it has to be considered that, in different culture media and in different hosts, certain physiological variations may occur, which might materially alter the morphology of a single species. Slight morphological differences in size and shape between two parasites in separate hosts are scarcely grounds enough for assigning new specific names. It may be necessary in all cases to conduct experimental infections of different hosts with the same flagellate in order to establish definitely its specificity.

A good example illustrating the above is seen in recent observations on *Herpetomonas muscarum* of the common domestic fly. Alexeieff (1913) pointed out that workers, in finding a *Herpetomonas* in a new host, assumed, therefore, it was a different species, and, as a result of this, there are in the literature numerous species, which, morphologically, are indistinguishable, e.g., *Herpetomonas muscarum* (Leidy, 1856), Kent, 1881. *Leptomonas drosophilæ*, Chatton and Alilaire, *Leptomonas pycnosomæ*, Roubaud, *Leptomonas ampelophilæ*, Chatton and Leger, *Herpetomonas luciliæ* Strickland, *Herpetomonas calliphoræ* Swingle, *Herpetomonas homolomyiæ* Brug, *Herpetomonas sarcophagæ* Prowazek.

Recently Becker (1923) has shown experimentally that *Herpetomonas muscarum* can infect *Musca domestica*, *Phormia regina*, *Lucilia sericata*, *Sarcophaga bullata*, *Cochliomyia macellaria* and *Calliphora erythrocephala*, and, by cross infection experiments with *Herpetomonas muscarum*, has also shown that *Herpetomonas muscarum*, *Herpetomonas luciliæ*, *Herpetomonas calliphoræ*, *Herpetomonas sarcophagæ* and *Herpetomonas* from *Phormia* and *Cochliomyia* probably represent the same species in different hosts.

Flagellates Noted by Various Observers in the Alimentary Tract of Mosquitoes.

The observations made above regarding the necessity for careful investigations of the morphology and complete life-histories of the flagellates in insects apply particularly to those found in mosquitoes. Many workers have encountered them during various researches, but, beyond the fact that they have recorded their presence, little information of a complete nature, except in a few instances, has been recorded.

Ross (1898) in a preliminary report on his investigations into malaria noted the presence of flagellates in mosquitoes, and, in 1906, he published an interesting communication drawing attention to his earlier observations. He encountered organisms with a single flagellum in several species of *Culex* and especially in the larvæ, pupæ and imagines of *Culex fatigans*.

They were also noted in anophelines.

Chatterjee (1901) on dissecting different anophelines found flagellates which he noted were like trypanosomes, and, in 1901, Christophers found heavy infections with similar organisms in a large percentage of anophelines and culicines, which he examined. He found these in the hind gut and rectum.

Durham (1902) in his memoir on yellow fever reported their presence in abundance in *Stegomyia fasciata*, which had fed upon a small cat.

Léger (1902) gives us the first descriptions with diagrams of a flagellate organism he found in the gut of *Anopheles maculipennis*. He named it a

new genus and species, *Crithidia fasciculata*, and this, with the description emended by Patton, is the type species of the genus *Crithidia*. Léger depicts two forms, one long, trypanosome-like, measuring 8 to 14 microns long, and one short, shaped like a barley grain, 3 to 4 microns long, but sometimes as long as 6 to 8 microns, with a flagellum almost the same length as the body. In the longer forms the flagellum took origin in a blepharoplast situated near the nucleus and anterior to it, and ran along closely applied to the edge of the body becoming free for a short distance at the anterior extremity. Léger and Duboscq (1902) again found the same organism in the gut of anopheline larvæ and the adults of *Anopheles maculipennis* in mid-winter in Corsica. Stephens and Christophers (1903) in the first edition of their text-book on malaria stated that flagellates frequently occurred in enormous numbers in the hind gut and rectum of mosquitoes, and, in the second edition (1904) they stated that, when stained, these resembled the developmental forms described by Schaudinn in *Trypanosoma noctuæ*.

Schaudinn (1904), on feeding *Culex pipiens* on *Athene noctua* (the little owl), found trypaniform flagellates and spirochætes in the gut of the mosquitoes, and he wrongly assumed that these were stages in the life-history of *Hæmoproteus* (*Halteridium*) *noctuæ*. His figures depict typical trypanosome forms, and, in view of the work of Woodcock (*vide infra*), it is possible these are developmental forms of *Trypanosoma noctuæ*, but until transmission experiments are carried out this is still *sub judice*.

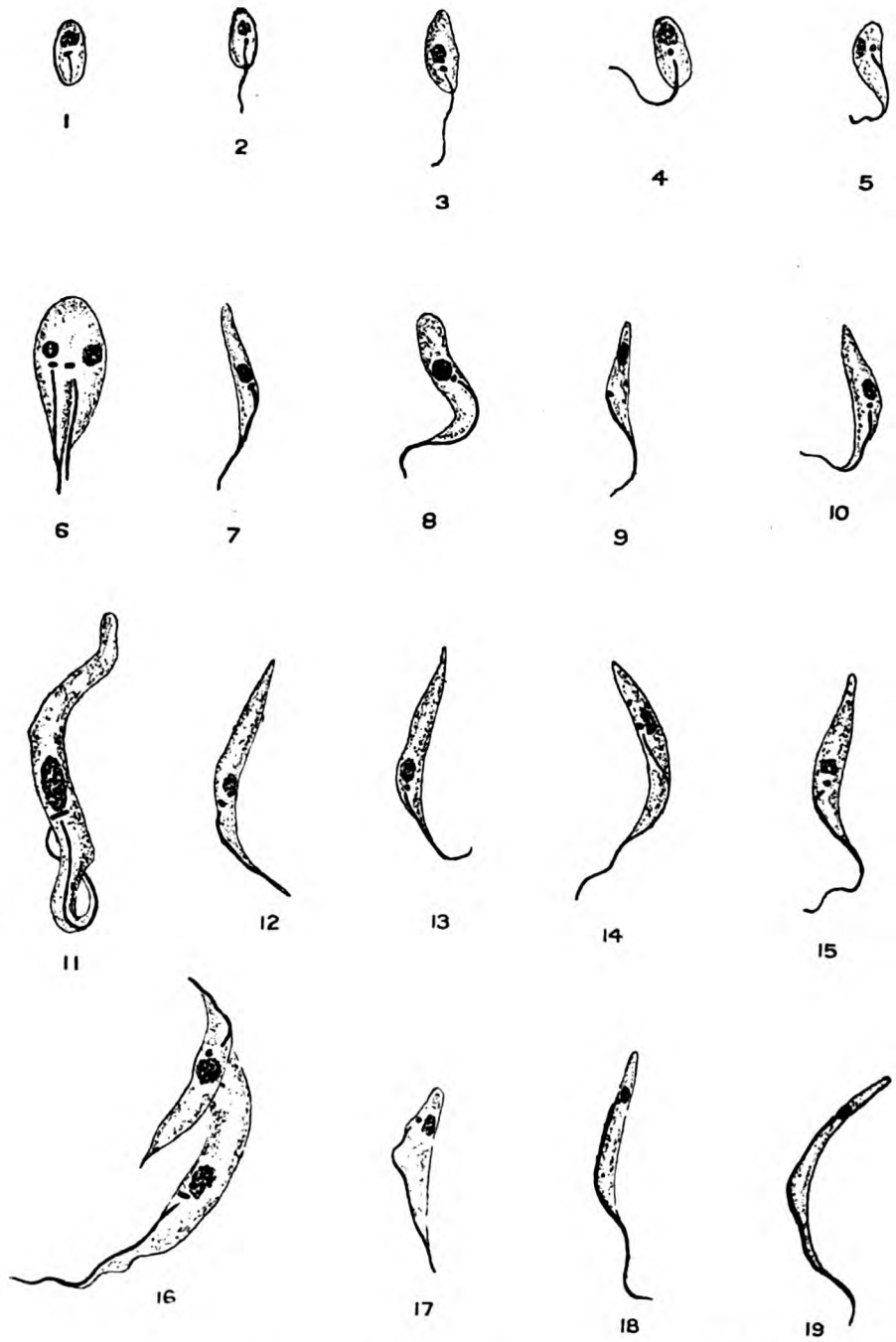
Lingard and Jennings (1906) found flagellates in *Culex* larvæ, and gave figures. From these it cannot be determined whether they were dealing with leptomonads or crithidia. In the same year Ed. and Et. Sergent (1906) noted and depicted leptomonads in 11 per cent. of the *Culex pipiens* examined and in one specimen of *Stegomyia fasciata* which were raised from larvæ in the laboratory. These they named *Herpetomonas algeriense*. The motile forms often occurred in large numbers in the first part of the hind gut. The body measured 12 to 15 microns and the flagellum 3·5 to 6 microns. In the same communication they reported from the larvæ of several anophelines and of one *Culex* and also in the nymph of a single specimen of *Anopheles maculipennis* a very long narrow leptomonad, which, they stated, resembled *Herpetomonas jaculum* of *Nepa*. The body of this was 16 by 3·5 microns, and the flagellum 24 microns in length.

Novy, McNeal and Torrey (1907) described two flagellates differing in morphology, namely *Trypanosoma* (*Herpetomonas*) *culicis* and *Crithidia fasciculata* in *Culex pipiens*, *Culex sylvestris* and *Culex triseriatus*. In one series of mosquitoes 55 had crithidial forms only, 52 had herpetomonads only, and 19 had both. These observers, however, have confused the generic names. *Trypanosoma* (*Herpetomonas*) *culicis* is really a *Crithidia*, and *Crithidia fasciculata*, according to Woodcock (1914) is not identical with Léger's organism, but is a leptomonad (*vide infra*). These flagellates should, therefore be known as *Crithidia culicis* Novy, McNeal and Torrey, 1907, emend Woodcock, 1914, and *Leptomonas fasciculata* Novy, McNeal and Torrey, 1907, Léger 1902, emend Woodcock 1914. The dimensions of *Crithidia culicis* were 7 to 35 microns by 1·5 to 3 microns, and the total length with flagellum 10 to 45 microns. Those of *Leptomonas fasciculata* were 3 to 4 microns by 2 microns, the organism being pear or cigar-shaped. Larger forms of this latter were about 8 microns with a free flagellum 2 to 5 microns in length. Adie (1907) noted flagellates in *Culex fatigans* and *Culex* sp., and in the same year Dutton, Todd and Tobey found clusters of bodies in the thoracic tissues of a female mosquito, *Anopheles paludis*. These bodies were club-shaped, and, when examined in salt solution, developed a flagellum. It is not possible to determine the flagellate from their description.

Mezinesco (1908) recorded *Crithidia fasciculata* of Léger in *Culex richardii* and *Crithidia culicis* of Novy, McNeal and Torrey on two occasions. Wenyon (1908) encountered crithidial forms in *Anopheles nili*, and in 1911 he found leptomonads in the larvæ and adults of *Stegomyia* sp. (probably *Stegomyia fasciata*). Patton (1912) noted the presence of leptomonads and crithidial forms in *Culex fatigans*, *Culex* sp., and *Anopheles stephensi* in Madras. He found *Herpetomonas culicis* (really a leptomonad) in the larvæ, nymphs and imagines of *Culex fatigans*. This organism occurred in over 95 per cent. of the larvæ taken from a septic tank, and it is interesting to note that it was not found in two other insects (viz., *Culex concolor* and a species of *Joblotia*) breeding in the same water. These leptomonads measured 15 to 25 microns in length by 3 to 5 microns in width, while the flagellum was 25 to 40 microns. Rounded forms, almost globular in outline, about 4 microns long were numerous at the point of junction of the Malpighian tubes. It was eventually established that this was a natural flagellate of the insect.

Franchini (1911 and 1912) on feeding *Anopheles maculipennis* and *Stegomyia fasciata* on cultures of *Leishmania* from infantile kala-azar found flagellates (leptomonads) in the gut of the insects, but these may have been natural flagellates. Laveran and Franchini (1913) reported *Crithidia fasciculata* Léger, 1902 in *Anopheles maculipennis*.

Woodcock (1914) described and figured crithidial forms in hibernating *Culex pipiens* in London, and noted their resemblance to *Crithidia fasciculata* of Léger, but, in a further communication (1914), he considered these so-called crithidia as seen by himself and Novy, McNeal and Torrey, were not similar to Léger's *Crithidia fasciculata*, but were leptomonads. He therefore altered the name to *Leptomonas fasciculata* (*Crithidia fasciculata*) Novy, McNeal and Torrey, nec Léger). The same observer, while studying the parasites of the little owl, found leptomonad, crithidial and trypaniform flagellates in the gut of *Culex pipiens*, which had previously



J. G. Thomson, del.

Flagellates in *Anopheles umbrosus*.

been fed on an owl containing *Trypanosoma noctuæ* in its blood. These forms compare with those found by Schaudinn, but Woodcock was unable to attempt transmission experiments. Mathis in 1914 at Tonkin found the salivary glands of a *Culex* sp. heavily infected with the crithidial and trypaniform flagellates. The crithidia were 21 to 23 microns long with a flagellum 12 to 15 microns long, while the trypanosome forms measured 10 to 15 microns. Curiously enough, he could find no developmental forms in the gut, and he suggests that he may have been dealing with the trypanosome of a bird. Noller (1917) during the cultural experiments described leptomonads in *Culex pipiens*, which he identified as *Leptomonas fasciculata*, and in 1920 Laveran and Franchini found leptomonad, crithidial and trypanosome forms in *Culex pipiens*. Joyeux in 1918 recorded crithidial flagellates in *Anopheles maculipennis* from Macedonia, while Wenyon (1921), also from Macedonia, reported the same type in *Anopheles maculipennis* and *Anopheles superpictus*. Lastly, in 1914, Schulz described *Leptomonas fasciculata* in the gut of *Culex pipiens* and *Theobaldia annulata*.

Description of the Crithidial Flagellate Found in the Gut of *Anopheles umbrosus*.

The films available for study, which were from two female anophelines, were five in number. Three smears were from the gut contents, and two were from the salivary glands of one of the mosquitoes. These latter showed flagellates similar to those from the intestines, and, as the possibility of contamination from the gut during the dissection cannot be excluded, undue emphasis will not be laid on their discovery in this situation. For the purposes of description it is more convenient to differentiate the various forms of the organism into certain types, which, however, it must be remembered, are merely stages in what is probably a continuous life cycle.

(*a*) Leishmania-like forms. These were fairly numerous. In outline they were ovoid, measuring about 4 microns in the long and 2 microns in the short axis. The nucleus was placed towards one end, and had the parabasal body fairly near it. In the majority of individuals a well-defined rhizoplast could be perceived passing from the neighbourhood of the parabasal body towards the periphery (*Vide* fig. 1.)

(*b*) Small ovoid flagellates. The length of these oval or sometimes pear-shaped forms, exclusive of the free flagellum, varied from 3·5 to about 5 microns, and the width from 2 to 3 microns. The nucleus still had the tendency to be towards one end of the body, while the flagellum, which took origin from its neighbourhood, ran directly through the body to become free at the anterior end. The flagellum usually measured about the same length as the body. (*Vide* figs. 2, 3, 4 and 5.)

(*c*) Piriform flagellates. These were most commonly found in process of division. They were 10 microns in length by 4·5 microns in breadth. It seems probable that these piriform specimens are the precursors of the crithidial forms described below. (*Vide* fig. 6.)

(*d*) True crithidial forms. This type predominated in all the films. In size there was considerable variation, short, intermediate and long forms occurring. The shape of the body was characteristic, being elongated and pointed at both ends. The length was from 8 to 15 microns. The nucleus varied in position, being sometimes central (figs. 11 and 12), sometimes slightly anterior (fig. 13), and most frequently posterior (figs. 17, 18 and 19). The free part of the flagellum varied from about 2 to 5 microns in length.

DESCRIPTION OF FIGURES.

All figures were drawn at a magnification of approximately 2,200 diameters, and were specimens from one mosquito.

Fig. 1.—*Leishmania* forms.

Figs. 2, 3, 4.—Short ovoid forms, flagellates.

Fig. 5.—Short crithidial form.

Fig. 6.—Division of short, piriform flagellate.

Figs. 7, 8, 9 and 10.—Short, typical, crithidial forms with short free flagellum. The nucleus in fig. 9 is posterior in position.

Figs. 11, 12, 13, 14, 15 and 16.—Large crithidial forms.

Fig. 16.—Two crithidia occurring together showing the great variation in length.

Fig. 17.—Short crithidia with the nucleus situated in a posterior position suggesting the development of a trypanosome phase.

Figs. 18 and 19.—Thin crithidial forms with nucleus situated posteriorly.

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NOTES BY A NURSE ON THE TREATMENT OF YAWS[1] (FRAMBŒSIA) WITH NOVARSAN.[2]

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INTRODUCTORY REMARKS.

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APART from their intrinsic value the following notes are interesting for two reasons.

They clearly show that one of the prevailing serious African diseases is readily amenable to appropriate treatment and will probably be annihilated in course of time. This is well known already.

They incidentally demonstrate the quality of the work which is being carried out by mission nurses in Central Africa, particularly supervised by the medical officer attached to the mission.[3]

It must be kept in mind that Great Britain is successfully administering huge areas in the vast continent of Africa with a mere sprinkling of British officials, that pioneers and settlers are scattered sparsely throughout the land, and lastly, that Government doctors are few and private practitioners do not exist in many of the dependencies, and that the natives for the most part have only their own witch doctors to fall back on when ill. That if the nurses of the missions working in Central Africa did not treat cases of illness because they have not professional qualifications as doctors, much suffering which they now alleviate would be left to take its own dire course.

These 30,000 attendances at a small out-station dispensary were all voluntary, many of the natives attending walked miles for treatment—nothing but good resulted. The doses of the *novarsan* were all well within the bounds of orthodoxy.

It is true that the novarsan was given intravenously and that a great measure of discretion was called for, for people of all ages and illness of all degrees were treated.

The nurse is by no means the only nurse in Africa who is doing this class of work, and perhaps it is as well to add that the nurses of the Universities Mission to Central Africa who are called on to do

[1] *Yaws* is a disease confined to the tropics. In its clinical manifestations it closely resembles syphilis. It is caused by the *Spironema pertenuis* of Castellani which is not easily distinguishable from the *Spironema pallida* of Schaudinn of syphilis. It is not venereal but is contracted by simple contact with another case.

Travellers and writers after visiting African countries are apt to pronounce that the people are eaten up with syphilis or rotten with the same. They are wrong in making this stupid and immoral implication.

It would be truer to say that a large proportion of the natives in many parts of Africa were disabled by the easily curable disease called yaws, which is mistaken over and over again for syphilis.—J. B. C.

[2] *Novarsan* is a form of Novarsenobensol.

[3] By Dr. Mary Iles, M.D.(Lond.), and latterly by Dr. Janet Murray, M.D.(Edin.).

medical work of this quality belong to the grade from which the sisters in charge of wards at the London hospitals are drawn; several in fact have been sisters at London hospitals to which medical schools are attached.

Miss Wilson touches on points of professional interest in connection with her work: (1) Can yaws be congenitally transmitted? (2) Are the organic arsenical preparations alone capable of effecting a cure in secondary yaws? (3) What dosage of novarsan, and what after-treatment is necessary for tertiary yaws?

She goes far to prove that many of the chronic crippling intractable ulcers and contractures met with in Central Africa are due to *yaws* and are readily amenable to yaws treatment.

Lastly, there is the question, when can treatment be suspended in a yaws patient? A test is necessary. When Miss Wilson next goes out I hope she will be equipped with a test.

Yaws is not the only serious tropical disease the nurses of the U.M.C.A. treat in Africa: malaria, dysentery, ankylostomiasis, and, not least of all, leprosy, are all in the daily round.

WHEN I was sent to do work for the Universities Mission to Central Africa, at a mission station twenty miles inland above Targa, in Tanganyika territory, East Africa, I found a district which, to a newcomer to Africa, seemed to be a hot-bed of disease, mainly yaws and ankylostomiasis. The natives of the district belong to the Bondei tribe and are people of poor physique, and ignorant of the elementary rules of hygiene and public health; to the indigenous people is added a floating population of Africans from the interior who find work on the numerous sisal plantations; these visitors bring a great deal of disease with them.

The following statistics will show the urgent need there is for medical treatment in Central Africa, and the increasing use by the Africans of the medical help afforded by the Mission, the patients coming from an increasingly wide area:—

(*a*) *Year ending December*, 1923.

Attendances at Mkusi Dispensary (out-patients)	=	12,021
New yaws cases (secondary and tertiary)	=	1,100
New ankylostomiasis cases	=	450

(*b*) *Year ending December*, 1924.

Attendances at Mkusi Dispensary (out-patients)	=	21,114
Secondary yaws (new cases) ... ... 429 Tertiary ,, ,, ... 1,402	=	1,831
Ankylostomiasis	=	1,782

The routine treatment for *yaws* was intravenous injections of *novarsan*.

Total number of *novarsan* injections for two years = 4,500.

(I) SECONDARY YAWS.

The first year's injection work consisted mainly in curing the acute cases, of which the district was full; these for the most part came up covered with the rash and in a very infectious condition. During the second year's work these acute cases were in the minority, and now a case of secondary yaws with a rash is hardly to be found in the entire district.

Each paid a fee, either in money or kind, varying from one to five shillings, according to age; in this way this special branch of medical work was entirely self-supporting, and the receipts for injections paid by the Africans in the Mkusi district alone for January to December, 1924, amounted to £251. Psychologically this charge seemed to increase the value of the treatment to the African mind, as they are accustomed to pay heavily for what is done for them by the native witch doctors. In many cases, however, the injections were given practically free, the patients, when cured, bringing the money up months later; generally this was earned by working on the sisal plantations. No patient was ever refused treatment because of real inability to pay.

The treatment of secondary yaws was quite straightforward, and *in most cases* patients were cured by one or two injections. Adults of male sex were given 0·45 grm. and women 0·3 grm., though the dose varied according to the individual. Patients reported at regular intervals *for months after being "cured,"* and all were given mercury by mouth as routine treatment.

The following are two typical cases:—

(*a*) April 11, 1923. *Miniamisi*, aged 2, acute yaws. Breathing very laboured owing to nostrils being blocked with sores. 0·15 grm. novarsan given.

May 2, 1923. Cured. No recurrence since.

(*b*) October 10, 1923. *Mtoro*. Body covered with rash, walked up fifteen hours to dispensary. 0·45 grm. novarsan given.

October 14, 1923. Cured. Returned home. No recurrence since.

Several cases of children were brought up with no rash nor any outward sign, but complaints of pains in joints, mainly elbows and knees; in a few cases the children were quite crippled. Injection into the vein at the elbow was found to be difficult, as great pain was caused by straightening the arm out on the table, and in some cases there was considerable contraction. These cases were diagnosed by the natives as being *the very earliest stage of yaws*; they were certainly all cured by injection and, as far as I know, were not followed by the rash. Namely:—

January 2, 1924. *Mamtai*, aged 7, carried up on his father's shoulders. No sign of yaws. No past history of yaws. Pain in arms and legs. 0·2 grm. novarsan given.

January 16, 1924. Cured. Walked up. Has been quite well since.

Exceptions and Complications amongst Secondary Yaws.

(*A*) *Secondary Cases passing into Tertiary even with Treatment.*—Some isolated cases, although apparently responding equally quickly as did the average patient for whom no further treatment was necessary, remained quite free for some months, generally about four, and then either developed the painful tertiary form in their feet, or an obstinate form of ulceration responding to no local treatment. This perhaps points to a lengthier course of injection being given than has been thought necessary after the disappearance of the rash. Namely:—

(1) November 4, 1924. *Valentino*, body covered with rash. 0·45 grm. given.

November 18, 1924. Body quite clear. Patient apparently well.
March 3, 1925. Tertiary form in feet. 0·41 grm. given.
(2) October 15, 1924. *Binto Umari.* Body covered with rash. 0·3 grm. given.
October 25, 1924. Body clear.
December 10, 1924. Tertiary form in feet. 0·45 grm. given.
(3) June 28, 1924. *Akida*, child of 8, body covered with rash. 0·2 grm. given.
July 19, 1924. Body quite clear. Patient apparently well.
September 3, 1924. Ulceration on ankle not responding to any local treatment. 0·3 grm. given. Ulcer healed quickly. No recurrence.

(*B*) *Secondary with Recurrences.*—A few cases of secondary yaws were extraordinarily obstinate, apparently different from the usual type in virulence, and completely contradicting the preconceived idea that every case of yaws was going to be cured by one, or at most two injections of novarsan. Namely:—

September 10, 1923. *Ramathani*, history of acute yaws for six months. Body covered with rash. 0·45 grm. given.
September 20, 1923. Improvement, not clear. 0·45 grm. given.
September 26, 1923. Still not quite clear. 0·3 grm. given.
October 3, 1923. Rash disappeared. Patient apparently well.
February 18, 1924. Body covered with rash again. 0·6 grm. given.
April 16, 1924. Body covered with rash again. 0·6 grm. given. Not reported since.

It was interesting to note that in two cases of women treated for secondary yaws and, as far as outward signs went, cured, in the early months of pregnancy, the rash recurred in both cases immediately after the birth of the baby. In one case the breast became infected and the baby developed yaws apparently through being suckled; in the other case the baby remained free.

In the case of a baby of three months old brought up suffering from acute yaws, there was the history of the father being under treatment for yaws just at the time the mother became pregnant. This may have been merely a coincidence. The baby was cured by 0·1 grm.

(II) Tertiary Yaws.

(*A*) *Hands and Feet.*—The majority of the patients during the second year's work were those suffering from the tertiary form affecting the hands or feet, very painful and disabling. To effect a cure more of the drug was necessary than in the case of the rash, and these cases were very liable to recur at the rainy season. Namely:—

July 10, 1923. *Bendera*, history of yaws thirty years ago hands quite sore and useless—palms split. 0·3 grm. given.
August 7, 1923. Great improvement, beginning to use hands again, and able to pound the corn. 0·3 grm. given. Cured.

(*B*) *Ulceration.*—At first sight most of the dispensary work in Africa seemed to consist in the dressing of dirty offensive ulcers, in some cases most extensive and not responding at all quickly to local treatment, but dragging on for months. Little by little it transpired that the majority of these patients had a past history of yaws so novarsan injections were tried, with the result that from January to December, 1924, only one per cent. of cases of ulceration did not require injection. The other numerous cases of ulceration were injected and healed rapidly in a week or two, the dressing in such cases consisting generally of old rag dipped in saline, done by a great number of the patients in their own huts.

The alleviation of suffering throughout the entire district due to the rapid healing of these ulcers can hardly be appreciated enough, nor the gratitude of the natives.

The following are some of the cases:—

(1) September 5, 1923. *Halifa*, ill twelve years, brought up twenty miles in a stretcher. Right leg and genitals covered with ulceration. 0·45 grm. given. Daily dressing.
September 12, 1923. Ulcers healing rapidly. 0·3 grm. given.
October 3, 1923. Quite well, *walked* home.

Patient has been seen on several occasions, when he brought up relations for treatment, and is quite well.

(2) June 17, 1923. *Deburi*, aged 10, very painful ulceration of feet, spent days on road and arrived quite exhausted. 0·25 grm. given—stayed in neighbourhood for daily dressing. Rapid improvement.
July 20, 1923. Ulcers healed. Patient quite well, walked home, twenty-five miles.

(*C*) *Loss of Power in Limbs.*—Another class of patients, also giving a history of yaws in childhood, who responded so quickly to treatment by injection were those suffering from loss of power in their limbs. Whether this is a form of tertiary yaws or not remains to be proved.

The following cases give their own story:—

(1) September 4, 1923. *Omari*, ill twenty years, no use in lower limbs, brought up in stretcher, had to be carried into hut for injection. 0·3 grm. given.
September 18, 1923. Still carried up but able to help himself into hut. 0·45 grm. given.
October 2, 1923. Walked two and a half hours from his village to the dispensary.
Reported at intervals for one and a half years.
(2) February 28, 1925. *Ali*, young man brought up in stretcher—no use in legs, history of yaws as a boy, sudden loss of power fifteen months ago. 0·3 grm. given.
March 21, 1925. Improved—able to walk from entrance of injection hut to table with help on both sides. 0·3 grm. given.
April 18, 1925. Walked up from his own village, two and a half miles with two sticks. 0·3 grm. given.
Case still under treatment.
(3) September 26, 1924. *Michael.* Left elbow very swollen and painful. Foments applied, no relief, lot. plumbi also unavailing. 0·3 grm. given—arm put in sling.
October 14, 1924. Arm quite normal and in use. 0·3 grm. repeated.
Reported at intervals—no further trouble.

OBSERVATIONS ON CASTELLANI'S FERMENTATION PHENOMENON.

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Castellani has described the following phenomenon: when to a bacillus producing simple acidity, never gas, in a given carbohydrate—as, for instance, maltose—certain bacilli are added which are inert on that particular carbon compound, viz., do not produce in it either acidity or gas, fermentation with production of gas may take place. Accord-

ing to Castellani, a condition for the phenomenon to take place is that the added bacillus, though inert on that particular carbohydrate, must be capable of producing gas in glucose.

The phenomenon may be described in other words as follows: Simple acid fermentation of certain carbon compounds caused by certain bacilli which never produce gas, may be turned into fermentation with production of gas by merely adding a bacillus inert on those particular carbon compounds, but capable of producing gas-fermentation in glucose. One would expect, of course, that by adding to an organism producing, say in maltose, simple acidity, never gas, an organism which does not produce either acidity or gas in that sugar, there would still be only production of acidity.

I have repeated some of Castellani's experiments and I will give here my results.

Organisms Used.—The organisms used are *Bacillus typhosus*, *B. morgani* (Morgan's Bacillus No. 1), *B. dysenteriæ* Flexner, and a strain of *B. proteus*. As is well known, *B. typhosus* and *B. dysenteriæ* Flexner never produce gas in any sugar; *B. morgani* produces gas in glucose, levulose and galactose, it does not produce either acidity or gas in any other carbohydrate. The strain of *B. proteus* I have used (Strain P) produces gas in glucose, levulose, galactose, saccharose and glycerol; it produces neither acidity nor gas in lactose, dulcitol, mannitol, maltose, dextrin, adonite, inulin, sorbite, inositol, salicin, amygdalin, isodulcitol or erythrite.

B. typhosus + *B. morgani.*

Action on Maltose.—*B. typhosus*, as is well known, produces acidity, never gas, in maltose; *B. morgani* produces neither acidity nor gas; the mixture *B. typhosus* + *B. morgani* produces acidity and gas.

Action on Sorbite.—*B. typhosus* alone produces simple acidity, never gas; *B. morgani* has no action whatever, it produces neither acidity nor gas; the mixture *B. typhosus* + *B. morgani* produces acidity and gas.

B. typhosus + *B. proteus.*

The strain of *B. proteus* used (P) as already stated has no action on maltose, mannitol or sorbite; it produces neither acidity nor gas in these substances.

Action on Mannitol.—*B. typhosus* produces acidity, never gas in this alcohol. *B. proteus* (P) has no action on it; neither acidity nor gas is produced. Their mixture, however, produces acidity and gas.

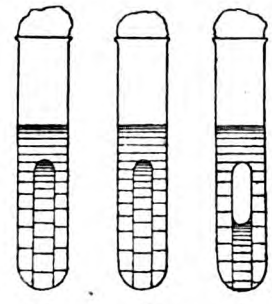
Action on Maltose.—*B. typhosus* alone produces acidity only, never gas; *B. proteus* (P) alone is inert, it produces neither acidity nor gas; their mixture produces acidity and gas.

Action on Sorbite.—*B. typhosus* produces acidity only; *B. proteus* produces neither acidity nor gas; their mixture causes production of acidity and gas.

B. dysenteriæ Flexner + *B. morgani.*

Action on Maltose.—*B. dysenteriæ* Flexner produces only acidity, never gas. *B. morgani* produces neither acidity nor gas; their mixture produces acidity and gas.

Action on Mannitol.—*B. dysenteriæ* Flexner produces acidity only, never gas. *B. morgani* has no action on it; neither acidity nor gas is produced. The mixture *B. dysenteriæ* + *B. morgani* produces acidity and gas.



1, Mannitol peptone water tube inoculated with *B. dysenteriæ* Flexner; gas absent. 2, Mannitol peptone water tube inoculated with *B. morgani*; gas absent. 3, Mannitol peptone water tube inoculated with *B. dysenteriæ* Flexner + *B. morgani*; gas present.

B. typhosus + *B. morgani* + *B. proteus.*

Action on Maltose, Mannitol and *Sorbite.*—*B. typhosus* alone produces neither acidity nor gas. *B. morgani* alone produces acidity, no gas. *B. morgani* *B. proteus* produces neither acidity nor gas. The mixture of the three germs produces acidity and gas.

Résumé and Conclusions.

My experiments confirm Castellani's work. The phenomenon he has described is the following: Two bacilli, neither of which causes production of gas in certain carbon compounds, may do so when artificially mixed together, provided one of them is capable of producing simple acidity (never gas) in those carbon compounds and the other, though inert on those carbon compounds (viz., does not produce in them either acidity or gas) is capable of producing gas in glucose.

For example, *Bacillus typhosus* never produces gas, only simple acidity in maltose, mannitol and sorbite; *B. morgani* alone is inert on those substances, viz., does not produce either acidity or gas; their mixture, however, produces gas, although one would expect that by adding to a germ which produces simple acidity, a germ which produces neither acidity nor gas, there would still be only production of simple acidity.

Similarly, neither *B. dysenteriæ* Flexner nor *B. proteus* (P) produces gas in mannitol; the first produces only simple acidity and the other is inert; their mixture, however, produces acidity and gas.

TABLE.

	Lactose	Saccharose	Glucose	Levulose	Maltose	Galactose	Mannito	Sorbite
B. typhosus	O	O	A	A	A	A	A	A
B. dysenteriæ Flexner	O	O	A	A	A	A	A	O
B. morgani	O	O	AG	AG	O	AG	O	O
B. proteus (P)	O	O	AG	AG	O	AG	O	O
B. typhosus + *B. morgani*	O	O	AG	AG	AG	AG	AG	AG
B. typhosus + *B. proteus*	O	O	AG	AG	AG	AG	AG	AG
B. dysenteriæ Flexner + *B. morgani*	O	O	AG	AG	AG	AG	AG	O
B. dysenteriæ Flexner + *B. proteus*	O	O	AG	AG	AG	AG	AG	O

O, negative, viz., neither acid nor gas produced.
A, acidity.
AG, acidity and gas.

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ACQUIRED IMMUNITY TO MALARIAL INOCULATION.

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IN connection with the malarial treatment of general paralysis of the insane in this hospital, we have endeavoured to produce a second series of malarial rigors in such cases as had not shown sufficient mental or physical benefit after a first infection terminated six or more months ago.

From the figures published from time to time by the originators of the treatment, we were led to believe that the inducement of a second series of malarial rigors was a matter of mere routine procedure. We were, however, surprised to find that such was far from being the case. Fourteen patients who were subjected to reinoculation, some even three times, showed no clinical signs of malaria.

To remove any possible doubt as to the technique of the inoculations we would say that we are aware that if only gametocytic forms of parasite were introduced no pyrexia could result. Proof that asexual forms were injected is to be found in the last column of the accompanying table, for in every case except one we can point to other patients who were inoculated from the same syringeful of the blood of the donor and who, later, developed true malaria, these patients being infected for the first time.

Having been confronted with such a definite im-

Case	Blood group	Age	First inoculation	Blood from Case	Blood from Group	Route	Number of rigors	Relapses	Subsequent change in C.S.F.	Subsequent inoculation	Blood from Case	Blood from Group	Route	Same blood successful in cases number—	Remarks
3	—	41	10/1/24	15	—	I.V.	7	Yes	—	29/4/25	STM	—	I.M.	94	
8	2	38	3/12/23	40	1	Mos.	11	No	No	27/7/25	97	4	I.V.	100, 101, 102	
17	4	36	11/4/24 I.V. 11/2/24	Mosquito		—	5	Yes	Yes	27/7/25	97	4	I.V.	100, 101, 102	
18	2	36	3/10/23	Mosquito		—	4	Yes	Yes	30/5/25	96	—	I.V.	—	
29	4	40	23/11/23	Mosquito		—	10	No	Yes	17/7/25	RS	—	I.M.	97, 98, 99	
30	—	59	3/10/23	STM	—	I.V.	—	—	—	31/7/25	97	4	I.M.	100, 101, 102	
40	1	32	31/3/24	Mosquito		—	9	Yes	Yes	31/8/25	102	4	I.M.	28, 77	
43	4	36	27/7/24	20	20	I.V.	9	Yes	Yes	17/7/25	97	—	I.V.	—	
										30/5/25	96	4	I.V.	97, 98, 99	
										27/7/25	97	4	I.V.	100, 101, 102	
										5/8/25	97	4	I.M.	*ibid.*	
										7/1/24	Mosquito		I.M.	53	This case was infected successfully before admission by mosquito
51	2	31	—	—	—	—	—	—	—	30/4/25	78	4	I.M.	79, 22	
										17/7/25	RS	—	I.V.	97, 98, 99	
53	4	30	9/9/24	43	4	I.V.	10	Yes	Yes	9/2/25	88	4	I.V.	—	
										3/5/25	78	4	I.V.	22, 79	
54	1	35	28/5/24	75	4	I.V.	7	Yes	Yes	17/7/25	RS	—	I.M.	97, 98, 99	
										5/8/25	97	4	I.M.	100, 101, 102	
62	4	48	29/4/24	8	2	I.V.	10	No	Yes	31/8/25	102	4	I.M.	28, 77	
										5/8/25	97	4	I.M.	100, 101, 102	
63	4	43	29/4/24	8	2	I.V.	3	Yes	Yes	31/8/25	102	4	I.M.	28, 77	
71	4	38	6/5/24	62	4	I.V.	6	No	Yes	31/7/25	97	4	I.V.	100, 101, 102	
										24/5/25	94	3	I.M.	—	
79	2	32	24/8/24	78	4	I.M.	2	No	Yes	17/7/25	RS	—	I.V.	—	
										11/2/25	88	4	I.M.	53	

munity we had, perforce, to search for some factor peculiar to these immune cases which might be correlated with this resistance to subsequent infection, especially as we have found only one case to be resistent to a *first* infection.

In so far as naturally occurring malaria is terminated as speedily as possible by the exhibition of quinine, and whereas, in contrast, therapeutic malaria is allowed to continue to the limit of tolerance we thought perhaps the number of rigors in the primary attack was responsible for the subsequent immunity and that relapses might also be a factor.

Our figures show that such is not the case. Reference to our table will also prove that the inoculation methods of neither the primary infections nor the subsequent attempted infections had any bearing on the matter.

It should be added that all the primary pyrexias have been terminated in the usual way by means of quinine, which was administered until the blood was definitely negative to microscopic examination.

Further, our reinoculations have been performed at widely varying intervals of from six to twenty months.

In view of the theory advanced in support of the I.K. treatment of tuberculosis, viz., "that the more important protective substances of an immunized blood exist chiefly, though potentially, in the erythrocytes," we, for a time, thought that the relationship between the blood-groups to which the various donors belonged, and those of the recipients might prove a fruitful field for research. It seemed possible that the hæmolysis consequent upon the mixing of different bloods might thereby liberate certain antibodies capable of having been produced by the first malarial attack.

The inoculation would necessarily account for an extreme dilution of such liberated antibodies, as is laid stress upon by those who support the I.K. theory.

Although having no practical experience of I.K. therapy and no real knowledge thereof, it seemed worth while to investigate and type the blood-groups of the cases under review. We were again disappointed to find that no conclusion as to the significance of blood-grouping, in this connection, could be drawn, especially as all our donors except one happened to belong to group 4.

Owing to the difficulty hitherto experienced in obtaining infected mosquitoes we can, at present, point to but one case (No. 51) where a subsequent infection has been attempted by all three routes inclusive of mosquito bite. Colonel S. P. James, of the Ministry of Health, has recently arranged to assist us in this matter, so we hope it will be possible at a later date to report further on this point.

Whether the serum of an "immune" patient will abort or prevent the development of a rigour we are not in a position to say, nor have we the opportunity to ascertain, as the results obtained from the malarial treatment of general paralysis of the insane appear to be so beneficial, in our experience, as to prevent our terminating the pyrexia before we are compelled to by the condition of the patient.

In this connection it may be of interest to mention that where the necessary tests have been performed on the "immune" patients we have found that only two have failed to show some change in the cerebrospinal fluid (cf. also *Lancet*, October 31).

Our chief reason for publishing our findings is that the further research into such an acquired immunity, especially if carried out under more propitious conditions than those prevailing in a mental hospital, may yield results important to preventive medicine, and that it may be of use to others to know even such negative findings as it has been our lot to obtain.

Our best thanks are due to the medical superintendent, Dr. F. M. Rodgers, for permission to make use of our work for publication; to Professor Mackie, of Edinburgh University, and to Dr. J. G. Thomson, of the London School of Tropical Medicine, for much encouragement and kindly advice.

Aleukæmic Leukæmia with Multiple Skin Tumours (John Alexander Drake, M.D., M.R.C.P., *British Journal of Dermatology and Syphilis*, August-September, 1925).—The patient, a young man aged 25 years, came under observation with multiple skin tumours, resembling in appearance those associated with leukæmia. Microscopical examination showed that the tumours were composed of masses of lymphoid cells. Most of the superficial lymphatic glands were enlarged, as was also the glandular tissue of the mouth and throat. None of the deep glands were affected. Sections of the glands showed marked diminution of the "germ centres." The most striking change in the blood was a well-marked leucopænia, which, however, was associated with a relative increase of the lymphocytes (aleukæmia). The marrow was redder than normal, and much more cellular. There was evidence of erythroblastic proliferation, but the most marked feature was the increase in the number of lymphoid cells. During the period of development of the skin tumours (about six months) the health of the patient was apparently normal, except for fleeting pains in, and swelling of, the joints. Later the enlargement of the glandular tissue of the throat increased to such an extent that ulceration and obstruction to breathing were caused and tracheotomy became necessary. When the patient first came under observation (i.e., when the skin tumours were already developed) no enlargement of the liver or spleen could be detected. During the later stages the spleen became palpable and eventually both spleen and liver were markedly enlarged. Multiple areas of necrosis were found post mortem in most of the organs. These areas contained large diphtheroid bacilli. It is probable that these necrotic areas were of quite recent origin and were a terminal feature.

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THE TREATMENT OF YAWS.

IN view of the similarity between the causal organism of yaws, *Spirochæta pertenuis* of Castellani and that of syphilis, *Spirochæta pallida* of Schaudinn, it would appear probable that the known antisyphilitic medicaments would have similar, if not identical, action on both these organisms and on the diseases which they produce. Experience, however, shows that mercury appears to exert little therapeutic action as compared with its powerful effect in syphilis, whilst potassium iodide is fairly efficacious, and the same remark applies to tartarated antimony (tartar emetic). The most efficacious and rapid results are obtained from the organic preparations of arsenic such as salvarsan, first introduced in the treatment of the disease by Castellani, Strong and Nichols, or better still, its more recent, more soluble and less toxic derivatives, which have an almost magical curative effect on yaws in every stage of the malady. Novarsenobillon given intravenously in doses of 0·9 grm. for adults, 0·6 grm. for young adults, 0·3 grm. for children up to 10, and 0·1 grm. for children under 2 years of age, the symptoms rapidly disappear and relapses are uncommon. The average time in which a cure is effected is generally said to be about eleven days. Some authorities prefer to give several smaller doses than this. They recommend three to six intravenous injections of novarsenobillon at three to six days' interval. If one injection only is given 0·4 to 0·6 grm. should be the dose; when a course of three or more injections is carried out 0·3 grm. should be given at the first injection, 0·4 grm. at the second, and 0·6 grm. at the third and subsequent injections. It is considered that the systematic use of neosalvarsan in a community afflicted with yaws would, if adequately carried out, thoroughly eradicate the endemic disease. This method of prophylaxis should therefore be enforced in such a community together with other measures such as isolation and segregation, disinfection and protection of skin lesions or abrasions.

The patient should, when possible, be kept at complete rest in bed for several hours after the injection, and in patients with cardiac lesions the neosalvarsan injections should be preceded by a hypodermic injection of caffeine. Occasionally the patient may complain of headache after the injections, and there may be a rise of temperature, but very seldom are serious symptoms caused by the drug, though cases of transient coma, delirium, epileptiform crisis, nephritis and jaundice have been recorded.

In cases in which intravenous injections are not feasible, the novarsenobillon may be given intramuscularly in doses of 0·4 grm. dissolved in oil, deeply into the muscles of the buttock.

The success attendant on the recent introduction of bismuth preparations in the treatment of syphilis has led to the employment of these preparations in yaws. An oily suspension of sodium-potassium-bismuth tartrate, containing 64 per cent. of bismuth and known as Trépol, has been used for intramuscular injections. A more recent preparation, Neo-Trépol, consisting of precipitated bismuth in an isotonic medium, is said to be more active. It is given in the same manner and in the same dosage.

Two injections at weekly intervals have been followed by favourable results in both secondary and tertiary yaws. A soluble form of sodium-bismuth tartrate is preferred by some: 6 gr. dissolved in 3 c.c. of distilled water constituting a suitable dose for an adult and 1 gr. for babies.

Patients with neglected mouths are liable to develop stomatitis as a result of the bismuth method of treatment. To obtain the best results attempts to improve the general health should accompany or precede treatment either by neosalvarsan or by bismuth injections—such as good food, warm clothing, tonics, and occasional aperients, and during convalescence iron, arsenic and quinine are indicated.

Injections of tartarated antimony (tartar emetic), as given in sleeping sickness, appear to produce much less satisfactory results than those obtained with neosalvarsan or bismuth, and there would appear to be no reason for their continued employment.

When neosalvarsan or bismuth cannot be obtained or where lack of medical men and skilled nurses makes intramuscular injections difficult or impossible, the oral administration of "Castellani's yaws mixture" will be found effective in many cases. This mixture contains tartar emetic gr. i, potassium iodide 5i, sodium salicylate gr. x, bicarbonate of soda gr. xv, water or chloroform water to 1 oz. One ounce is given thrice daily diluted in three or four times the amount of water, to adults and youngsters of over fourteen years; half doses to children of eight to fourteen years of age, and one-third or less to younger children. To Europeans it is advisable to give half doses, as they do not stand full doses as well as do natives. The mixture is given in the doses mentioned for ten to fifteen days; it is then discontinued for about a week, and then given again for another ten to fifteen days. The results obtained by this method of treatment are very satisfactory in recent and fairly recent cases, and may be compared with those obtained by the salvarsan treatment. In chronic cases, however, the results are not so striking, and for these cases the treatment by neosalvarsan or bismuth, whenever possible, should be employed. F. E. T.

Annotations.

A Study of Methods of Disinfection of Eating Utensils in the U.S. Army (Major Starr A. Moulton, *Military Surgeon*, September, 1925).—The existing regulation in regard to the cleansing of eating utensils requires an excessive amount of heat for disinfection. This is difficult of accomplishment and necessitates the use of improvised and generally unsatisfactory equipment in most kitchens. Based upon the author's considerations, the following modifications of this regulation are recommended: Immersion of the eating utensils after thorough washing and rinsing in water at 75° C. for five minutes instead of boiling or steaming for ten minutes. The routine use of towels is not to be permitted except for the drying of metal equipment, such as knives, forks, spoons, &c. These, after thorough washing, rinsing and drying, should be placed in a hot oven for the completion of disinfection. This measure is recommended to eliminate tarnishing. To accomplish the proper disinfection of eating utensils when mechanical dish-washers are not available, the author is of the opinion that the use of live steam is most practical and convenient.

Studies on the Ætiology of Jagziekte. I. *The Primary Lesions* (E. V. Cowdry, *Journal of Experimental Medicine*, September 1, 1925).—Observations showed that the lungs of South African sheep, in a district in which jagziekte is appearing sporadically, differ from those of normal American sheep. Their structure is in general variable. They are more subject to the action of bacteria, demonstrable histologically, and to the effect of inhaled foreign material. The most significant difference, however, is found to centre in the interalveolar tissue, which in about 33 per cent. of the animals is definitely thickened beyond the range of variation in this direction observed in American sheep. The thickenings occur in localized areas several millimetres in diameter. They begin with engorgement of the alveolar capillaries and accumulation of macrophages and of lymphocytes. Many of the macrophages pass into the alveolar lumina and assume the appearance of typical epithelioid cells. These infiltrative and exudative changes are primary to the epithelial proliferations which always arise in tissues modified in this way and which it is proposed to describe in a second paper.

Studies on the Ætiology of Jagziekte. II. *Origin of the Epithelial Proliferation and the Subsequent Changes* (E. V. Cowdry, *Journal of Experimental Medicine*, September 1, 1925).—The epithelial proliferations, which are so typical of jagziekte, are chiefly of alveolar origin. They appear in areas of infiltration and exudation identical histologically with those occurring in sheep which are to all appearances normal, but which are derived from flocks in which the disease is endemic. They become very extensive and quite atypical in structure, but they never give rise to metastases, even to the adjacent lymph-glands. The primary infiltration of the interalveolar tissues continues and may lead to fibrosis and extensive consolidation, or leukocytes may accumulate in large numbers, penetrate into the alveoli and form areas of acute pneumonia. In fairly advanced cases of jagziekte it is common to find many stages of the reaction in one and the same lung. While it is possible that the disease may be due to a single and specific virus, and the epithelial lesions are certainly of a very special character, the pathological complex as a whole is such as might be caused by a variety of predisposing and exciting factors operating over a considerable period of time.

Goundou (Dr. J. N. Roy, *Revue de Laryngologie, d'Otologie et de Rhinologie*, January 31, 1925).—This malady is fairly frequent in natives of the Ivory Coast and the Gold Coast, but it has also been observed in nearly every other part of Africa. Cases have been met with in Asia, Oceania, Mexico, Brazil and the Antilles, and in all places no race is exempt from the disease. It is more frequent in males than in females, and appears in people of all ages. The true ætiology of goundou is unknown, although many theories on the subject have been put forth. When goundou is paranasal very grave complications affecting the eyes may set in; and when it is generalized, muscular and articular troubles are often present. As regards treatment, chirurgical methods are the only means of curing the tumours of the face; arsenicals, &c., have no curative action on the disease, but when it is generalized a cure is practically hopeless. Thirty-four cases of goundou are described in this paper.

Observations on Filariasis, Yaws and Intestinal Helminthic Infections in the Cook Islands, with Notes on the Breeding Habits of Stegomyia Pseudo-scutellaris (A. McKenzie, *Trans. Royal Society Tropical Medicine and Hygiene*, June 18, 1925).—In this paper some valuable statistical data are given of a hitherto uninvestigated portion of the Pacific. It deals chiefly with the islands of Rarotonga, Aitutaki, Mangaia, and Atiu. A geographical description is given of each of these islands. Disease due to *Filaria bancrofti* is general throughout the group, and is manifested in a variety of symptoms. The main filarial accidents that cause natives to seek treatment are abscesses, filarial fever (lymphangitis) or elephantiasis. The youngest case in which microfilariæ were found was 12 years old. The disease occurs more often in males than in females, and is less frequently found in native women of the better class who do not work in the fields, and live in the most luxurious types of houses. An attempt was made to discover all the varieties of mosquitoes present in Rarotonga. *Culex fatigans*, *Stegomyia fasciata* and *S. pseudo-scutellaris* were found in large numbers. Intestinal parasites are not rare in these islands; *Necator americanus* is the commonest. Carbon tetrachloride proved efficacious in the treatment of these affections. The author has treated 200 cases of yaws during the past twelve months. Both sexes are equally affected, and the age in which it most frequently occurred was between 4 to 8 years; there was also a large number of cases between 8 to 12 years and over 20 years. The position of the primary sore varied. Conclusions drawn from these cases are: The primary sore is of identical appearance with the secondary sore and occurs on a wound or ulcer. It rarely appears on a breach of skin surface that has healed aseptically. Although in American Samoa it is considered that affection is carried by flies, owing to the numbers of primary sores which appear on the face, especially on those places which are being constantly picked by children, the author considers that it is more often carried direct from patient to patient by the intervention of fingers. Secondary rash and desquamation have never been observed. None of the cases showed the initial fever and joint pains of the classical picture. Fifty-one cases presented lesions of the feet and no other active signs; these cases heal quickly under treatment with novarsenobillion. Sixteen cases of definite tertiary yaws have been seen.

The Incubation period of Benign Tertian Malaria (G. de M. Rudolf, *Annals of Tropical Medicine and Parasitology*, July 16, 1925).—The incubation period of the naturally-acquired benign tertian malaria is given by most authorities as being from six to twenty-one days, with, however, wide variations. In thirty-four cases inoculated by means of anopheline mosquitoes, the incubation period varied from seven to thirty days as measured by the first date on which parasites were found, and in thirty-seven cases from seven to twenty-five days as measured from the first rise of temperature. Subcutaneous inoculation of malarial blood gives, according to a number of writers, an incubation period of from one to thirty-two days. A series of fifty general paralytics inoculated subcutaneously with *Plasmodium vivax* showed that 90 per cent. gave a rise of temperature of from 101° F. to 102·9° F. in less than ten days. The first rise of temperature over 103° F. occurred within twenty-one days in 84 per cent. and within ten days in 38 per cent.

Following subcutaneous inoculation there is a well-marked correlation between the first rises of temperature to 101° F. and to 102° F. and the first finding of parasites in thin films. The frequency curves of the first finding of parasites in thick-films and of the first rise of temperature to 101° F. are very similar, although the observations were made upon two different series of cases inoculated with two different strains of parasite. Curves of the first finding of parasites in thin-films and the first rise of temperature to 103° F., in the same series of cases, are also somewhat similar. Intravenous inoculation of malarial blood gave an incubation period of from one to nineteen days in a series of sixty cases. In a series of twenty-eight cases, inoculated intramuscularly at Bexley and Winwick Mental Hospitals, the incubation period varied from six to twenty-three days. In ten series of cases injected subcutaneously with malarial blood it was found (*a*) that when similar numbers of parasites were injected the incubation periods were of somewhat similar lengths, and (*b*) that when different numbers of parasites were injected the incubation periods showed a marked tendency to be shortest when the dosage of parasites was the greatest. In one series of four cases this relationship did not hold as regards the first series of temperature, but only as regards the first dates on which parasites were found. In most series the length of the incubation period as measured by the first time that parasites were

found, under standard conditions, corresponded more nearly to the dosage than did the length of the period as measured by the first rises of temperature.

A New Medium for the Diffentiation of Bacillus coli in Water Analysis (J. L. Pawan, *Annals of Tropical Medicine and Parasitology*, September 30, 1925).—*B. coli* (lactose +, indol +) may be isolated by the standard method not only from fæces and polluted waters, but also from unpolluted soils and unpolluted waters. As a standard indicator of fæcal contamination its value is not, therefore, unquestionable. Local experience indicates that the utilization of citrate by *B. coli* may be of value in differentiating fæcal from non-fæcal *B. coli* in water analysis.

The Morphology of Mastigina Hylæ (Frenzel) *from the Intestine of the Tadpole* (Elery R. Becker, *Journal of Parasitology*, June, 1925).—*Mastigina hylæ*, an inhabitant of the posterior intestine of the tadpole, first reported from Argentine by Frenzel, shows the following characters: An amœba-like body and an amœboid type of movement. A nucleus at the extreme anterior end. A basal granule situated on the nuclear membrane, from which arises a short inactive flagellum, a rhizostyle, and a cape covering the anterior surface of the nucleus from which radiating threads are distributed to the periphery of the rounded anterior end of the cell. The structure of this protozoon may serve as a ground plan for the morphology of other entozoic flagellates, such as *Trichomonas*, *Chilomastix*, and even *Giardia*.

The Fallacy of the Test for Lactose Fermenters as an Indication of fæcal Pollution of Waters (Otto Schobl and Jose Ramirez, *Philippine Journal of Science*, July 1925).—The fallacy of the test for lactose fermenters as an indication of fæcal pollution is evident from the following conclusions:

1. Even though lactose fermenters other than true *B. coli* are frequently present in human and animal fæces, due to their wide distribution in nature and their presence in places where fæcal contamination is excluded, these bacteria as a group cannot be considered as an indication of fæcal contamination.

2. On the other hand, we are justified in considering true *B. coli* as an indicator of fæcal pollution owing to its relatively limited distribution outside of the human and the animal body.

3. True *B. coli* can be fairly readily differentiated from the other members of the coli group by the type of its colony on eosin-methylene-blue lactose-agar plate.

4. Comparative tests of *B. coli* strains failed to yield any criterion for the differentiation of *B. coli* of human origin from *B. coli* of animal origin.

5. Under natural conditions the pollution of water by *B. coli* originating from the fæces of water-living animals such as fishes, frogs and insects is not likely.

Malaria Infection as it occurs in Late Pregnancy; its Relationship to Labour and Early Infancy (D. B. Blacklock and R. M. Gordon, *Annals of Tropical Medicine and Parasitology*, September 30, 1925).—Malarial infection of the placenta is very common in native women in Sierra Leone; it occurs in about 36 per cent. of cases. Infections demonstrable in the peripheral blood are in comparison few, not only in parturient women, but also in non-parturient women, adult males, and even in children. The difference between the placental and peripheral incidence is in all probability due to a peripheral blood immunity. These intensely-infected women are practically negligible as a source of danger to the community, so far as gamete production and consequent anopheline infection are concerned. Pathological effects on the mother may be entirely lacking. The children may in some cases be born and survive, and may appear free from any effects. On the other hand, this series contains in other cases proof of a very complete association between maternal infection in the placenta and death of the child *in utero*, or within a seven-day observation period after birth. Examination of a large number of infected placentas showed that severe destruction of the erythrocytes may occur in the umbilical cord in spite of the absence of congenital malaria. The effects upon the child are explicable on the grounds that toxic substances are absorbed from the intensely-infected placenta of the mother, and that the accumulation of masses of infected red cells interferes seriously with the nutrition of the fœtus.

An Experimental Study on the Development of the Dwarf Tape-worm (Hymenolepis nana) (Yoshihisa Saheki, *Annals of Tropical Medicine and Parasitology*, September 30, 1925).—The six-hooked larvæ of the dwarf tape-worm about ten hours after ingestion penetrate the villi in the upper part of the small intestine and four days later become encysted larvæ (*Cysticercus*). Five days after ingestion well-developed larvæ emerge from their cysts and leave the villi. After seven days well-developed young dwarf tape-worms have some segments at the end of the body. After nine days their reproductive organs become visible. About fourteen days after ingestion the segments are full of eggs, in each of which can be seen a six-hooked larva (onchosphere). After about seventeen days the ripe eggs of the dwarf tape-worms are found in the fæces of the experimental animals. These experiments show that dwarf tape-worm eggs, which have been evacuated with the fæces of the host, are swallowed by animals or man with their food, and that the eggs hatch and the six-hooked larvæ are liberated in the small intestines, and later enter the villi of the small intestines, where they become encysted larvæ; then emerging from the cysts they grow into young dwarf tape-worms and upon maturity evacuate the ripe eggs. Therefore, without any intermediate host, the dwarf tape-worm can directly develop in the body of mice, rats, young monkeys, or man, especially children.

Current Literature.

INDIAN MEDICAL GAZETTE.

October, 1925.

Stibosan ("*Von Heyden* '471'") (L. E. Napier).—Stibosan, the sodium salt of meta-chlor-para-acetyl-amino-phenyl stibinic acid, was first introduced for the treatment of kala-azar by the author at the Calcutta School of Tropical Medicine about two years ago, and the first report was published in December, 1923. Since then the compound has been used in a large number of cases, and its value has been confirmed, not only by the author, but by other observers. The drug is now obtainable in sealed ampoules containing either 0·2 or 0·3 gr. The required dose should be dissolved in sterile distilled water in order to make a 5 per cent. solution. The solution should *not* be boiled and should be prepared freshly. Comparatively strong adults can be given 0·2 gr. as initial dose and 0·3 gr. subsequently. More debilitated ones can be given 0·15 gr. initial dose and 0·25 subsequently; very debilitated patients should be given 0·05 gr., subsequent doses being increased cautiously. Children tolerate the preparation in relatively larger doses. Only two contra-indications are given to the use of stibosan in kala-azar, i.e., jaundice and ascitis. This preparation has many advantages over other preparations of antimony, one of the chief being that only about 12 injections are necessary to complete a cure instead of the usual 30 to 40 necessary with antimony tartrates. Various common sequelæ of intravenous injections of the tartrates are practically unknown when stibosan is used. It is also a stable substance, and does not undergo any change on exposure to air.

Izal in Cholera (Lalbehary Ganguly).—Izal has been given a fairly extensive trial in the Cholera Ward of the Campbell Hospital, and the results have not been as great as might have been expected. The author considers that izal, in the treatment of cholera, cannot be put on a higher level than any other drug so far tried. It is at a distinct disadvantage compared with others that have no irritant action on the kidneys. So far as any specific action is concerned, there is not much to choose between any of the drugs in common use *provided the drug exhibited has no irritant action on the kidney*. Success, of the standard of an 80 per cent. recovery amongst the pulseless cases, lies in judicious administration of salines and alkalies.

A Note on the Toxic Symptoms of Organic Arsenic (A. Denham White and R. Sahib Sital Chandra Dutt).—The authors call attention to the alarming sequelæ which may attend the treatment of syphilis by intravenous injections of arsenics; the danger lies chiefly in the fact that in the present state of knowledge there is no method of estimating the tolerance of any particular individual to the drug. Three cases are reported: In Case I nitritoid crises followed the administration of organic arsenic by injection, which ended fatally. The symptoms in Case II were similar to those in Case I, but the patient was removed from hospital and lost sight of. In Case III the patient developed jaundice after the injection and died shortly after. These symptoms may be averted by the use of adrenalin.

Soil Acidity and Survival of Hookworm Larvæ (A. C. Chandler).—It would appear from results obtained by experiments that the acidity likely to be present in ordinary agricultural soils, at least up to a hydrogen-ion concentration of 5·5, does not interfere with the survival of hookworm larvæ. This is contrary to the prevalent opinion that acidity in soil has a tendency to shorten the life of infective hookworm larvæ.

The Staphylococcal Kidney in Childhood (E. H. Vere Hodge).—In this paper the author calls attention to the danger of staphylococcal pyelitis and pyelonephritis of early childhood, in which there is direct evidence of the tonsil being the primary focus of infection. Four cases are reported which show the gravity of acute tonsillar affection in children. Some cases are accompanied by septicæmia, which progress rapidly to a fatal termination. In some cases there is marked acetone reaction in the urine in the early stages of the disease; although it is considered that this has no special significance, it should nevertheless not be neglected lest convulsions or coma should supervene.

Acute Inflammation of the Prostate (Henry Smith).—This disease is of more frequent occurrence than one is led to believe by the literature on the subject, and is very often misdiagnosed in surgical practice. The result of this is that the case is temporized with and allowed to declare itself by an abscess opening into the rectum or into the bladder. The general rule in cases which burst into the bladder or rectum is that they should be left to drain by that route without further interference. This, in the author's opinion, is quite wrong. When the abscess has burst into the bladder, the proper procedure is to pass a lithotomy staff and make a small lithotomy-sized wound and drain both bladder and abscess. In case it empties into the rectum, the sphincter should be freely incised and the front wall of the rectum right up to and into the abscess cavity. Another error which is pointed out is the general belief that gonorrhœa is the chief cause of this condition.

Reviews.

MANSON'S TROPICAL DISEASES. A MANUAL OF THE DISEASES OF WARM CLIMATES. Edited by P. H. Manson-Bahr, D.S.O., M.A., M.D., D.T.M. and H., F.R.C.P. Eighth Edition. With 20 Coloured Plates, 7 Half-Tone Plates, 387 Figures in the Text, 6 Maps and 33 Charts. 1925. Cassell and Co., London, New York, Toronto and Melbourne.

Manson's "Tropical Medicine" has long been a classic, and has now reached its eighth edition—the first to appear since the death of its original author.

Sir Patrick Manson. The editor, Dr. P. H. Manson-Bahr, has thoroughly succeeded in his endeavour to bring it abreast of the latest development of this branch of medicine. To do this the volume has been drastically revised, and indeed remodelled, the only portion of the work as it came from the pen of Sir Patrick Manson and retained for its historical interest is the introduction of twenty pages on the Etiology of Tropical Diseases. Not the least important part of the book is the appendix of 232 pages, comprising Section A—Medical Zoology; and Section B—Laboratory Methods. The former comprising medical protozoology, helminthology, entomology and herpetology has been entirely rewritten, many new illustrations having been introduced. Fresh illustrations have also been inserted in other sections, ninety-four being new to this edition, including four full-page plates. The editor is to be congratulated in keeping down the size of the volume, for, in spite of the large quantity of new matter for which room has been found, he has succeeded in making this edition shorter than the last by some seventy pages. By the appearance of this excellent edition the continued popularity of Manson's Tropical Medicine is assured.

Fifty Years of Medical Progress (1873-1922). By H. Drinkwater, M.D. Published by H. K. Lewis and Co., London. Price 10s. 6d.

The subjects are treated in alphabetical order. Under the heading "Anthrax" mention is made of Koch and Pasteur. The latter already in 1857 had made the startling assertion that fermentation is due to organic life. Mainly through his efforts vaccination against anthrax was successfully introduced. Several pages are devoted to the anatomy of the brain, brain surgery having of late years made great strides. In the 70's Joseph Lister, professor of clinical surgery, was waging his heroic war against wound sepsis. People sneered at him and called his ideas fads; Koch, however, supported him and in a book on "Wound Infection" made his ideas known in Germany; now sterilizing is universally practised.

In the pages dealing with drugs and their discoveries, attention is drawn to the valuable work done in this respect by Emil Fischer, of Berlin. Notice is drawn to the great progress made in "Embryology" in late years. The article on "Eugenics" is interesting, but the unemployment problem is not in any way solved by the oft-repeated assertion that the unemployed are too often unemployable. In the section on "Germs" a rapid enumeration is made of all contagious diseases, and the discoveries made regarding leprosy, dysentery, typhoid, kala-azar, yaws, &c.

Much attention has been given to the "Heart" during the past half century, and important discoveries in its anatomy and physiology are recorded. A list is given of the most important works on medicine and surgery which have appeared during the period under review. "Immunity" is very fully treated and blood transfusion is dealt with in the same section. Mention, too, is made of "Malaria" and the noble work of Ross, Manson, Celli and others in their efforts to discover the cause of this strange disease and to stamp it out. Many ideas on the nervous system and its diseases have been modified of late years and the war has thrown new light on many points that were hitherto obscure. *Sanitation* and *Sanatoria* come in for due notice and allusion is made to the different Factory Acts.

Under the heading "Surgery" mention is made of *Bone-grafting*, which, though so widely used during the war was practically unknown until the present century. Sir Arbuthnot Lane's method in the treatment of fractures, or rather preventive measures, is one of the most striking innovations of the past half-century. These are stray gleanings from the rich harvest of experience gathered together in the book. It has some good photographs of many distinguished medical men and a useful index. The paper, printing and binding are all of the excellent quality we have learned to expect from the firm of Lewis and Co. The compiler, Dr. Drinkwater, has prefaced the book with an outspoken foreword. He is evidently a man who says what he thinks and means what he says.

Artificial Sunlight and its Therapeutic Uses. Second Edition. By Francis Howard Humphris, M. D. (Brux.), F. R. C. P. (Edin.), D.M.R.E. (Cantab.), 1925. Oxford Medical Publications.

The value of heliotherapy or the use of the actinic rays of the sun in the treatment of disease has been long recognized, but the use of artificial sunlight for this purpose, due to the ultra-violet rays contained therein, is of quite recent growth, and is quite parallel to the growth of other branches of therapeutics, for, as Rollier points out, "Sun and ultra-violet rays bear much the same relation to one another as crude drugs do to their synthetically prepared chemical substitutes." In this volume Dr. Humphris has excellently succeeded in his attempt to put in handy and simple language the main conclusions that have been arrived at, experimentally and clinically, by authoritative research workers and to embody some of the more important results with ultra-violet radiation attained in his own practice. It will be found a safe guide to practitioners in a comparatively little known region of physical therapeutics. After chapters on the ultra-violet rays historically considered and on ultra-violet rays—facts and fallacies—comes an excellent description of the apparatus employed, namely, mercury vapour lamps, both air cooled and water cooled, and arc lamps of carbon, tungsten, or iron, or a mixture of these and certain other elements. The therapeutics of ultra-violet rays and technique of treatment are then described. A long array of diseases for which ultra-violet rays are employed, including as specially amenable tuberculosis, rickets and many skin diseases. The tropical diseases for

which this treatment is mentioned as applicable are sprue and Leishman's sore. X-ray as a complement to actinotherapy provides the last chapter, and a sufficient bibliography and good index complete the volume.

LEPROSY. By Sir Leonard Rogers and Ernest Muir. 12s. 6d. Published by John Wright & Sons, Ltd., Bristol, and Simpkin, Marshall, Hamilton, Kent & Co., Ltd., London.

This book refutes the oft-repeated saying that leprosy was unknown in Europe until it was brought back from the East by the Crusaders, for in it we are told that Pompey's soldiers brought it to Italy B.C., and it was known in Germany in the second century. In the eighth century Pepin, King of France, passed a law making marriage with a leper illegal and the disease a sufficient cause of divorce for those already in wedlock. It was introduced into the New World by the African slaves that the Spaniards brought over to work in the mines and on the plantations. It appears to be more common among men than among women. The disease is not hereditary, as had long been supposed. Children of leper parents, if taken from them shortly after birth, grow up healthy and have healthy offspring. The disease is caused by the bacillus of Hansen discovered in 1872. No other organism has ever resisted the efforts of bacteriologists so long. It has never yet been cultivated *in vitro*, or outside of the human body. Inoculations into guinea-pigs, rats and mice have proved negative. It is very contagious, though the mode of infection is not yet known to a certainty. Probably the bacillus enters the organism through skin abrasions or through the mucous membrane. Among bare-footed races the lower extremities are generally found to be the first parts affected. The conditions favourable for propagation are a hot moist climate, low condition of civilization, bad sanitary arrangements and poor food. The number of cases found in Norway, where much fish is eaten, caused Sir Jonathan Hutchinson to name it "Fish-eaters' gout," but this can hardly be considered conclusive, as it is almost unknown in Greenland, where fish is also the staple food. No age is quite exempt, but the most susceptible periods seem to be from five years of age upwards till puberty; the liability to contract the disease diminishes after 30. If treated medically from the onset it is probable that the disease would never reach the stage at which it becomes contagious, but the long incubation period (average 3½ years) makes its early treatment difficult; ignorance and fear are the chief obstacles that the doctor meets with in his fight against this fell plague. The arguments for and against segregation and isolation are dealt with exhaustively in the book, and charts and diagrams show the results obtained under different conditions of treatment.

The book is divided into sections. It contains many illustrations showing the disease at different stages of development or treatment. No absolutely efficacious remedy has yet been found, but the malady is no longer considered as hopeless. Oils, ointments, caustics, injections subcutaneous and intravenous, have all been found beneficial, and the manner of administration and comparative charts showing results already obtained make the book more helpful to the physician who for the first time finds himself faced with the leprous patient. A thing that often makes early treatment difficult is that leprosy has symptoms that are common to many other diseases. A whole chapter is given to this subject; the book also contains minute directions for bacteriological examination of patients, and so that the practitioner may not forget the rules of ordinary prudence, cases are cited of doctors who have infected themselves while examining or operating upon leprous patients.

The Indian Lepers' Act, as amended up to 1920, is given as an appendix, also the official text of the resolutions of the International Conference on Leprosy assembled in 1923; the latter in French. A good alphabetical index at the end of the book will be found very useful by the busy doctor. The book is perfectly up to date, having been published in the first month of the present year. Paper and binding are fairly good and the printing clear. The numerous charts and diagrams show that most minute and conscientious attention has been given to the subject.

The authors are to be congratulated on the success of their labour.

SWANZY'S HANDBOOK OF DISEASES OF THE EYE. 13th edition. By Louis Werner, M.B., F.R.C.S.I. Published by H. K. Lewis & Co., Ltd., London. Pp. xvi + 698, with illustrations including coloured plates. Demy 8vo. Price 21s. net.

The thirteenth edition of Swanzy's "Diseases of the Eye" has now appeared under the able editorship of Mr. Louis Werner, who has done his work well. The present edition has been completely and carefully revised, especially in connection with diseases of the iris, of the ciliary body, and of the chorioid, the accounts of which have been, in part, rewritten. Notwithstanding this, and the addition of a few illustrations, as well as many minor alterations and additions, the volume has only been increased in size by some twenty-odd pages. It thus retains its well-known characters. The student and practitioner will find a sound and reliable guide to the subject of ophthalmology in this handbook, and we have no hesitation in warmly recommending it to his notice.

New Preparations, Inventions, &c.

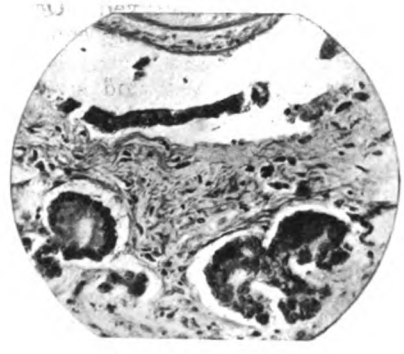
SULFOXYL SALVARSAN.—This preparation has recently been issued by Messrs. Meister, Lucius and Brüning, of Hoechst, in a 5 per cent. solution ready for immediate use. Sulfoxyl Salvarsan is chiefly used in the treatment of tertiary syphilis, and is now being employed by a number of hospitals and V.D. centres in this country.



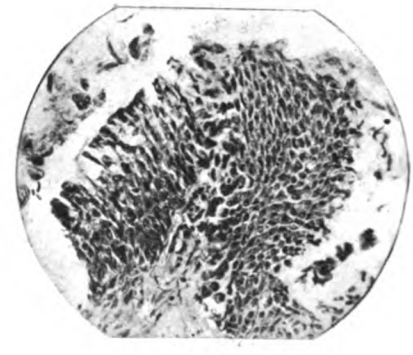
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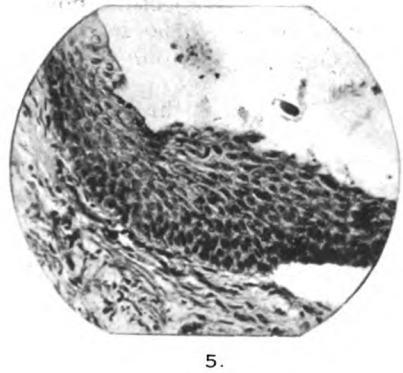
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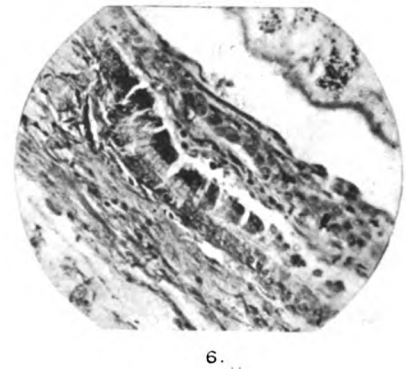
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To illustrate "The Pathology of *Clonorchis* Infection of the Pancreas," by H. B. NEWHAM, C.M.G., M.D., F.R.C.P.

Original Communications.

THE PATHOLOGY OF *CLONORCHIS* INFECTION OF THE PANCREAS.

By H. B. Newham, C.M.G., M.D., M.R.C.P., &c.
Department of Tropical Pathology, London School of Hygiene and Tropical Medicine.

Clonorchis sinensis is a parasite which, when infesting man, is commonly found in the liver, living in the bile-ducts of that organ. This condition is well known, and the pathological lesions associated with the presence of the parasites in that organ have been studied and described by several authors.

The fact that these parasites may also, on occasion, be found infesting the pancreas has also been noted. Thus in Byam and Archibald's [1] "Practice of Medicine in the Tropics" it is stated with regard to these flukes, "In heavy infestations a few are found in the pancreatic ducts and duodenum." Again, Manson-Bahr [2], in Manson's "Tropical Diseases," says, "Some instances are recorded of the presence of this trematode in the pancreatic ducts, in the duodenum, and in the stomach, and of the complication of ascites and even of anasarca." Brumpt [3] also states that when the infestation is intense the pancreas is generally invaded and altered.

It would appear, therefore, that although the liver is the organ *par excellence* to be invaded by these parasites, it is only occasionally that the pancreas also is involved, and then only where the infestation is a massive one.

I have recently had the opportunity of examining pancreatic tissue invaded by these parasites. The history of the origin of the tissue is unknown, as it was found among the stock of pathological material belonging to the Department of Tropical Pathology of the London School of Hygiene and Tropical Medicine, and, unfortunately, no particulars of its origin, or of the case from which it was obtained, were available.

In examining this tissue with the naked eye, one was at once struck with the large size of the ducts, in which in several places parasites could be seen in the lumens. To the feel, the tissue seemed somewhat hard and tough, as if due to fibrotic thickening. Sections of the tissue were prepared and stained by various methods for a detailed examination of the pathological changes.

It is generally stated that the pathological changes produced by these parasites in the pancreas are similar to those produced by the same parasite in the liver, but investigation showed that in several respects the changes noted differed notably from those seen in the latter organ, of which a large number of sections were examined for purposes of comparison.

On microscopic examination of the pancreatic sections the most conspicuous change was the marked enlargement and thickening of the pancreatic ducts.

This thickening was due to a marked increase of the fibrous tissue which was dense and well-organized. Embedded in this fibrous tissue were a number of secondary, generally incomplete ducts. (fig. 3). These ducts, lined by a single layer of columnar epithelium, appeared to be an attempt by the organ to form subsidiary ducts to relieve the main duct, markedly blocked as it is by the parasites.

The parenchymatous cells of the organ abutting on these thickened ducts are somewhat atrophied, apparently from pressure, and, in some cases, show fatty degeneration. No definite changes could be made out in the islands of Langerhans, but the whole organ appeared to show some increase in the amount of fibrosis, constituting a mild form of cirrhosis.

Epithelial Changes.

The normal lining of a pancreatic duct is a single layer of columnar epithelium (fig. 1). In the ducts inhabited by *Clonorchis* this epithelium is almost invariably destroyed. Occasionally, some remains of this cellular lining can still be observed, (fig. 2), but, in such a case, the individual cells are considerably altered, and somewhat atrophied.

Later, in some of the affected ducts a new epithelial lining may be developed. This lining consists of cells of a different type, being of a squamous, flattened variety. These cells form a definite layer, many cells thick (fig. 5), the whole resting on a delicate substratum of fibrous tissue, which would appear to be separate from, but resting on, the dense fibrous tissue of the wall of the duct. This thickened epithelial lining appears, in some instances, to be actually superimposed on the remains of the old columnar cell layer, and in such instances one can see a very definite layer of these heaped-up squamous cells resting on a delicate base of fibrous tissue, and overlaying the somewhat atrophied cells (fig. 6).

It is difficult to conjecture how this squamous-celled lining comes to be formed, as it does not appear to show any definite origin from the underlying tissue.

In rare instances, this heaped-up stratum of squamous cells may actually project into the lumen of the duct as a definite papillomatous-like growth (fig. 4), and such an appearance suggests the possibility of the latter taking on malignant characters.

It may well be that in the accounts of the later stages of clonorchiasis, in which it is stated the patient may suffer from recurring jaundice, ascites, general emaciation, and cachexia, such symptoms may be in keeping with an ultimate malignant condition.

This peculiar epithelial hypertrophy is not, in my experience, seen in the liver, and would appear to be peculiar to pancreatic infections. The underlying causes of these marked changes in the tissue of the pancreas are a matter of conjecture. Seeing that the ducts in many cases are practically completely occluded by a mass of the

parasites in the lumen, this mechanical blocking would appear to act as the stimulating agent in inducing the organism to endeavour to form new subsidiary ducts in the thickened wall of the main duct (fig. 3), in order to allow the secretion of the gland to find a channel for its exit.

The peculiar epithelial changes described are difficult to account for. Possibly the presence of large numbers of the parasites in the ducts may produce a definite irritative effect.

On the other hand, the parasites may produce some irritative toxic substance, which, escaping into the lumen of the duct surrounding the parasite, may be responsible in great measure for the abnormal cellular proliferation.

REFERENCES.

[1] Byam and Archibald. "Practice of Medicine in the Tropics," vol. iii, p. 1796.
[2] Manson-Bahr. Manson's "Tropical Diseases," 8th edition, p. 554.
[3] Brumpt. "Précis de Parasitologie," 3rd edition, p. 348.

ON THE MODIFICATION PRODUCED BY RADIUM ON AN EMULSION OF AN ADENO-CARCINOMA OF THE MOUSE AND ITS TRANSFORMATION INTO A CURATIVE VACCINE.

By Prof. G. Tizzoni,
The Royal University of Bologna,
Prof. E. Cetanni,
The Royal University of Modena,
and
G. de Angelis,
Professor of General Pathology.

In the most intense advance of the study of malignant tumours, we think it opportune to state in the present note how much we have been able to observe in experiments, which, even if preliminary, have at least been precise and repeated, concerning the action of radium on adeno-carcinoma of the mouse, and offer, as far as we go, the basis of a work of most ample growth, which involves a boundless succession of practical and scientific questions.

The specific cure of tumours, notwithstanding the many ways which have received extensive trial, does not yet allow a light to arise on the horizon. A brighter ray seems now to have arisen in the recent announcement of Gye and Barnard; but a critical examination of this research, although shedding a little light on the nature of the filtrable virus of chicken sarcoma, in no way illuminates the genesis of tumours common to the mammalia, and above all nothing appears from these studies towards solution of the problem of cure.

As the source of material therapeutic for the affections produced by a virus, there always remains the efficiency of the ancient principle that that which among the pathological products is of direct value is produced during the growth of the virus itself as being chiefly suited beneficially to influence the course of the disease which is derived from it, and is that which can still, at the present day, inspire the greatest faith in the study of cancer and other malignant tumours.

To ensure a profitable result it is not absolutely necessary that the nature of the virus be known; in many diseases, in fact, there is a filtrable virus, as in rabies, variola, infantile paralysis, encephalitis lethargica and many others, and the principal scientific and practical problems in reference to these were studied by the investigation of the pathological products directly obtained, though ignoring the morphological characters of the virus and the possibilities of culturing it artificially.

In these cases the essential solution of the problem consists in finding in these products, which contain the virus in natural culture, the certain conditions which determine the fatal limit of the death of the virus without at the same time causing damage to its vaccinating properties.

This problem is precisely that with which the present research is concerned, taking for its subject adeno-carcinoma of the mouse and for its destructive agent radium, with its known potentialities on tumours, and the possibility of guarding against its effects.

For such studies, for which we feel that our previous researches have fitted us, we have necessarily invited the resources of our respective institutes, thereby supplementing the deficiencies as a special centre for the study of cancer which our own district unfortunately possesses.

We have thus made use of the amount of radium possessed by the Institute of General Pathology in Bologna, and for the tumour an adeno-carcinoma transplanted through a long period and preserved at its full virulence in the Institute of General Pathology in Modena.

The dose of radium consisted of 0·10 grm. of pure bromide of radium, safely enclosed in a little box of the English type, with a potency of 500,000 U.R. per centigramme and a total of 5,000,000.

The tumour with which we worked is famous for its study by Ehrlich and later by many other authors. Suffice it to say that it presents the classical histological findings of mammary adeno-carcinoma, that with grafts beneath the dorsal skin in mice, after an incubation period, which, in cases of the greatest virulence, lasted exactly five to six days, but which, on the average, was about ten to twelve days, constantly produced granules of pure neoplasm nodular and characteristically lobed with unlimited power of increasing in size and which always attain considerable dimensions until at last it reaches a mass equal to, and sometimes beyond, that of the animal bearing it, and finally terminates by becoming ulcerated and determining the death of the mouse.

The attachment of the graft succeeds in 100 per cent. of the experiments, only in the rarest cases, and then only in old animals or during pregnancy

and lactation, the graft may end in total failure, although in this case there is an initial growth, but this is followed by complete re-absorption.

As regards the technique employed in this research, we have adopted that already used in the same institute in Bologna in the investigation of the action of radium on the virus of rabies and on that of variola vaccine.

Researches on the action of radiation, by Roentgen rays and by radium, made on tumours *in vivo*, which are very numerous, are of no value in our problem. It is admitted that the tumour can be destroyed by two quite distinct mechanisms, either directly by the action of radiation on the neoplastic cells, or indirectly by the action of atrophy-producing substances which are obtained from neoplastic material when subjected to the working of radiation. This double action cannot be differentiated during radiation *in vivo*. In this case, however, some indication of this indirect factor can be deduced by comparison with its more frequently observed retrogressive action on metastases at a distance from the radiated points. This indirect action of radiation is now admitted, by which radiation excites the production of inhibitory principles in the tumour and produces their action by way of the general circulation.

The study of our problem was conducted upon emulsions made with isolated tumours. Researches by this method have been made tentatively, but not in sufficient numbers and without having led to concordant and definite conclusions. The most regardful agree with those of Wedd and of Chambers, Morton and Russ, who found that the cells of tumours radiated *in vitro* are in a special condition to confer a state of immunity, but that if the radiation is too protracted the immunity sinks to zero. The most active rays appear to be the β, whilst the γ possess only slight action; Haarland, however, does not confirm these results.

Our researches may be arranged in three series, to which we refer successively:—

(1) Modifications produced by Radium on the Pathogenic Power of Cancerous Emulsion.

In this first series we proposed in the first place to see if and what action radium exercised on cancerous emulsion when in contact with half the usual amount of aluminium, and in the affirmative case we wished to establish what is the time which this contact ought to be maintained, so that decomposition should result until complete annulment of pathogenic power as ascertained by grafting into mice.

In order to avoid the influence of the surrounding temperature on the activity of the cancerous emulsion, as well as on the substance exposed to the action of the radium, as much as that of the control being kept up to the moment of grafting in an ice-chest at a temperature of not more than 4° to 5°.

In this first series of experiments we very easily succeeded in establishing the extreme limit of the scale of decomposition determined by radium on cancerous emulsions.

In fact, after 2½, 5 and 10 hours radiation the grafts of the radiated cancerous emulsion constantly gave positive results, determining the growth of a tumour which, whether judged by the brevity of the period of incubation or by its course and results, could in no way be distinguished from that obtained with the control grafts of the same emulsion, but not radiated.

Hence from these results we are able to affirm that by our dose of radium at ten hours exposure to radiation the cancerous emulsion preserves its pathogenic power intact.

Equally easy was it to find the upper limit. When the exposure of the cancer-emulsion to radium was prolonged to forty hours it was successful in every case, being indifferent as to when it was injected into the mouse, and this even if the observation of the animal into which the graft had been made was continued for many months. Indeed, the controls operated on with half of the emulsion not exposed to radium, but maintained in conditions identical to those of the radiated, constantly presented tumour growth without any modification as to whether the grafts had been practised from animal to animal with fresh emulsion.

From this we have been authorized to conclude that forty hours exposure to radium of our dose constantly and definitely annulled the pathogenic power of the cancerous emulsion of the adenocarcinoma of Ehrlich.

If, perchance, it is thus possible easily and successfully to establish the extreme grades of action of radium upon cancerous emulsions in regard to the time of radiation, it is not otherwise easy to obtain with absolute precision the intermediate grades, which, for us, present the greatest interest.

In this respect we have now been able to demonstrate that twenty hours radiation has represented the uncertain fatal limit, and that twenty-four hours radiation has constituted the fatal limit somewhat lower, according to the present finding.

In fact, in three animals operated on with emulsion exposed for twenty hours the result was not less sure and constant, although with diminished effect; of these two only succeeded positively, but with much retarded growth of the tumour, after thirty-five and sixty-one days respectively, and with a course somewhat slower than usual, though the result was always lethal. In animal No. 3 the result remained permanently negative. Indeed, after twenty-four hours' radiation the effects were constant, that is, no positive grafts in the mice treated with emulsion for this period of time.

From this it may be concluded that twenty hours radiation are not yet sufficient completely to annul the pathogenic power of cancerous emulsion and that the minimum time in which to obtain this effect as revealed by us is twenty-four hours. There still remains a restricted space

of four hours time to be explored to reveal it and how it behaves in the two times presently found; that is, we propose to undertake further research, precisely directed to filling up this gap. So far, according to the actual state of the matter, we can present this scale:

After 10 hours radiation ... No demonstrable action
„ 20 „ „ ... Incomplete and inconstant action
„ 24 „ „ ... Complete and constant action

In the presence of these results one most important consideration has not escaped notice: the analogy which the behaviour of cancerous material in the presence of radium reveals with other diseases undoubtedly due to filtrable viruses, such as rabies, Jennerian vaccinia, &c.

(2) Beneficial Effects produced by Properly Radiated Cancerous Emulsion on the Course of Developed Cancer.

In order to determine better the numerical limit of inactivation of the radiated cancerous emulsion in so far we wished to see if, like emulsions completely deprived of their pathogenic action, they had curative properties like that submitted to twenty-four hours of radiation, as this should be very near to the real fatal limit.

The results obtained in this series of experiments are as successful as they are encouraging. We have, indeed, observed that the injection of 2½ c.c. of the emulsion radiated for twenty-four hours made into the tumour which had already visibly grown and had reached considerable dimensions (maximum diameter 20 to 25 mm.) arrested the growth of it and brought about its gradual recession until it had completely disappeared. This involution of the neoplasm is accompanied by a peculiar softening of the tumour which becomes pulpy and little by little disappears without leading to ulceration and without producing any lesion whatever in the overlying skin. Later researches will describe what are the histological modifications which accompany the reabsorption of the tumour and complete cure.

Only exceptionally, when to the injection of the emulsion there is added some external mechanical cause, even merely the pressure exerted by the collodion applied to protect the part, there may be observed a dry aseptic necrosis of the tumour, at first partial and then extending to the whole of the neoplasm, which cleanly separates from the surrounding normal tissues by a limiting sulcus. It is ultimately cast off, leaving the impression of its contour which forms a sort of sac beneath the tumour, a process of repair and regeneration of the skin and sometimes some fine hairs. Instead, if in the cure of the tumour cancerous emulsion radiated for forty hours by the method indicated was used, success was quite indifferent, and the neoplasm followed its course to a lethal issue, without any appreciable difference from the controls. Therefore, between the fatal limit with conservation of the curative vaccinating power and that a little more elevated at which the vaccinating property also disappears, there intervenes by how much is now known, a long period of time, which in our experiments was found to be sixteen hours.

With this then we have established that the emulsion radiated for twenty-four hours, although it has completely lost its pathogenic power, has yet preserved a good part of its vaccinating powers, so that it acts most effectively on the same tumour as that from which the emulsion was derived, determining its complete disappearance, having acted as a curative auto-vaccine.

None can avoid the importance of this conclusion in that the proper grade of radiation can make the vaccinal effects comparable to the proper attenuation of a virus or of the respective cultures first revealed by the immortal genius of Pasteur in the transformation of the virus of vaccinia.

(3) Mechanism of Action of Properly Radiated Cancerous Emulsion in the Cure of Cancer.

After having recognized the curative action of cancerous emulsion the need spontaneously arose of knowing by what mechanism this action is exercised. And more precisely if this beneficial effect can be ascribed to the category of direct action, whether, that is to say, it should be related to the induced radio-activity conferred by the radium and afterwards to the emanations and radiations which the radiated emulsion has liberated in the heart of the tissues into which it was injected during the period of disactivation; or whether it should be ascribed to the category of indirect action, whereby the effect of the vaccinating principle developed in the emulsion under the influence of radiation.

To this end we have activated a solution of an indifferent salt, choosing physiological solution of sodium chloride and exposing it to radium for the time necessary to leave a clear impression on a photographic plate, equal in intensity to that left by the cancerous emulsion under identical conditions.

The radiated saline solution was then injected in the amount of ½ c.c. round a tumour already arrived at various periods of growth without producing in the neoplasm any modification in its development, course or issue. The death of the animal supervened in the same time as that of the control. Equally negative results were obtained with cancerous emulsion kept in the ice-chest for twenty-four to forty hours, but without being exposed to the action of radium.

It still remained to be seen whether an emulsion of physiological origin conveniently radiated had the same effect as the cancerous emulsion on tumours heavily developed; we observed that the mouse exhibited much sensitiveness to the toxicity of the degeneration products of heterogeneous tissues.

The completely negative effect of the control permits of the conclusion that it is not to the induced radio-activity acquired by the cancerous emulsion by the effect of its exposure to radium and not merely to the preservation of this emulsion in the cold for a time equal to or greater than that which serves to confer the vaccino-curative power on the

radiated emulsion, to which the efficacy of this last is due, as if the same constituents of the cancer which are found in the relative emulsion and to its transformation in a curative vaccine at once totally lost by the action of radium its pathogenic power.

By means of radium we have thus arrived at the basal result of future research, that is to say, to destroy completely the pathogenic power while preserving completely or in a great proportion its vaccinating properties, which in like manner are in evidence to advantage in the preparation of an auto-curative vaccine by which the cancerous emulsion, as in the better viruses, counteracts alike harmful matter and useful matter, distinctly or in reciprocal transformation. We are thus brought back to the ancient touchstone, the spear of Achilles, which had the power of healing the wound which it produced.

Up to now we can say nothing of the properties of this vaccine which we propose to study intensively to know especially its scientific and practical ends; if and how much it maintains its activity; how much in the liquid state and how much in the dry state; whether it be possible or not, its greatest concentration and preservability; if it be possible to succeed in separating it from the inactive and encumbering material; if it acts locally only and in the surrounding zone of the tumour, into which it has been exclusively injected in these tests, or if the same efficacy is verified when the vaccine is introduced into distant parts, because its use should not be limited to tumours which are external or in readily accessible situations.

Equally one cannot speak at this state of the research on the possibility of its application to man, whether, that is to say, one can prepare an auto-vaccine for human use which will have an effect equal to that prepared for mice.

For this purpose there will still be opportunity to determine in priority the question whether every vaccine would possess specificity exclusively for the tumour from which it was derived or whether the vaccine from a tumour would possess the polyvalency necessary to be of service for more varieties of tumour.

In the first sense, we shall speak of the failures in man of the therapy found useful for tumours in animals; in the second, the parimmunity brought to light by the researches of Ehrlich, and, more particularly, by the recent studies of Gye and Barnard, which indicate that the oncogenous virus is constituted by the necessary co-operation of two factors, one specific and one general. In our case the vaccine may be attached either to the general factor, and then its task will be rendered extremely easy, or to the specific factor, and will then encounter in its attenuation the very greatest practical difficulties sometimes insurmountable, and it will be, above all, necessary to establish a careful selection of the radiation useful in the special case, among which the manifold nature that analysis reveals emanates from the radio-active substance.

Hence, without wishing to revive excessive illusions, at present we can only say that our actual experience offers at least a first solid support for the continuance of the research up to the point at which the results obtained authorize us to try the test in man, and in the meantime to furnish once again the demonstration that here is opened one way to arrive with well-founded hope at the solution of a cruel problem which is at once scientific and humanitarian.

A STUDY OF SOME REMOVABLE CAUSES OF UNEMPLOYMENT AND CRIME.

By F. G. Cawston, M.D.Cantab.

(Read at the Congress of the S.A. Association for the Advancement of Science, held at Oudtshoorn, C.P., July, 1925.)

PSYCHO-ANALYSIS is of little practical value, except as it has taught us means of preventing delinquency and mental disease and has revealed causes of unemployment and crime which can be removed.

Unemployment, crime, the native question and the missionary programme may be regarded either as of academic interest only, merely as nuisances to the well-to-do citizen, or as providing a task for those who are prepared to take their share in the solution of these problems, by emphasizing a need which they can in part supply. It is a cause for satisfaction that the Government is tackling the whole subject of unemployment so bravely and is endeavouring to separate the various classes of unemployed, which will ever remain as a problem for the Government, the municipalities, philanthropic bodies and the individual.

Efforts have sometimes been made to find employment for all, without due consideration of the ability of the unemployed workman. In some instances unemployment, like crime, must be regarded as a disease for which there is a sufficient explanation, if this is sought for; and, sometimes, the cause can readily be removed by appropriate treatment.

Among the *physical causes* of unemployment which I have encountered whilst acting as a member of the Juvenile Affairs Board at Durban may be mentioned: squint, nystagmus, osseous growth at the knee (removed by operation), short sight (corrected by spectacles), bilharzia disease in a mentally deficient lad, deafness, advanced dental caries in a lad complaining of the cigarette craving and under a suspended sentence for the theft of bicycles, deflected nasal septum (requiring operation), extensive nasal discharge (cured by nasal douching), flat foot.

Any of these conditions may conceivably lead to either unemployment or crime.

As the liquor craving is commonly associated with crime in the adult, so the cigarette craving is sometimes associated with crime in the juvenile adult. My experience in general practice convinces me that, in many cases, the lure of liquor may partly be explained by indigestion due to dental caries or to a persistent high blood-pressure, and that an incorrect

diet may often lead to a craving either for liquor or for cigarettes.

One gentleman requested me to get his wife of 72 into an inebriates' home; but I found her condition quickly responded to treatment, when three decayed teeth had been extracted and an acid condition of the stomach had been corrected.

It has been suggested that some form of *moral instruction* be given as part of the school curriculum in Natal. The lack of commercial morality, gentlemanly behaviour in public and respect of parents must be regarded as essential causes of delinquency among juveniles in the present day. The rushed meals and lack of real home life tend to lessen a child's respect for its elders.

A mother once complained to me that her boy was repeatedly stealing *her* cigarettes!

Then I do not see how it is possible to deal with the case of the released prisoner or with the juvenile who is placed under a suspended sentence, until some further efforts are made to compel them to pay back what they have stolen or, by other means, to get right with those they have wronged.

Attention has recently been given to the desirability of imparting definite information in regard to the *sexual life* to those boys and girls who attend the Government schools in Natal. The vast majority of young persons derive their first knowledge of sexual relationship from their companions, either at school or at the cadet and scout camps, and many of them are exposed to the conversation of natives about these matters on their way unattended to school or on their way home. The increase of divorce and the large number of children who have been rendered fatherless as a result of the recent war has accentuated the problem; for a growing lad needs a father as much as he needs a mother. Parents tend to forget that, as a rule, children have few of those evil ideas associated with sexual things which are common in later years.

Some teachers hold that conscience is a sufficient guide for the school-child; though most teachers of experience are wide awake to the tendencies towards sexual indiscretion that exist in schools and *do* give occasional words of warning to their scholars. Although it is dangerous to allow a child to leave school without some definite instruction in regard to the sexual life, it is difficult to see how each can be reached individually.

A lad was brought to me who had been up before the Durban magistrate for sexual crime. Up till the age of fifteen, when he left school, he had taken no interest in sexual things; but, being out of work for a few months after leaving school, he had been led to indulge in what he believed to be the practice of married persons. In this case there would appear to be little fear that he would continue as he did, as soon as his ideas of sexual things had been corrected.

There are some strong reasons against sexual instruction in schools being entrusted to the unmarried lady school teacher, and I have great doubts of the value of those portions of botany and natural science which have been chosen to prepare the child's mind for the sex problem as it affects the human race. It would be better to make such instruction more thorough and to confine it to the older children. It is most important that sex instruction in schools should contain nothing that is contrary either to science or to scripture, and that means that those who are to impart it must have a thorough knowledge of both. It is the lack of these two essentials that is responsible for practices which no true scientist or God-fearing person could entertain for a moment. What veterinary surgeon would entertain the possibility of tearing away the "after-birth" before it is properly formed in the womb, or would attribute a strong fertility on the part of the male to lack of control? Yet these are views which are held far too commonly and little is done to counteract them.

Those who advocate the definite education of our rising generation as to the principles of the sexual life must guard against the tendency to overeducate; for an outlet is needed for the sexual instinct of young people which is quite independent of reason. There are some valuable instincts associated with the sexual part of our being, such as modesty, migration and the desire to possess what is pleasing. These may run riot if left to themselves, and every boy and girl needs to be safeguarded against the possibility of these instincts carrying them into wrong channels.

So far, sexual instruction in schools has been rather of a corrective than of a positively instructive nature. It has been general to regard all manifestations of the sexual nature as wrong and requiring restraint. This has caused endless anxiety in many earnest young persons; for, throughout their school years, they have been given to understand that all sexual thoughts are necessarily impure ones.

Unemployment is an important cause of juvenile delinquency, and, although it is difficult to see how best to lessen the obvious results of overcrowding and the undesirable home surroundings in which many juveniles are placed, mention should be made of the large number of families which are drifting into the towns, through lack of employment on the farms, and the tendency of such persons to engage in liquor-selling to natives and Indians with the regrettable influence which such illegal practices must have on their children.

Efforts have been made to get into touch with all juveniles who come before the Durban courts and are known to be living in undesirable surroundings, and, in various parts of the Union, hostels are being formed for young persons who have no homes of their own, whilst looking out for employment or until such time as they may become self-supporting. Particular attention should be paid to juveniles under a suspended sentence, or to those who have associated with criminals in or out of gaol.

Conclusions.

(1) Although unemployment and crime must be recognized as insoluble problems under present conditions, there is often some physical or mental cause for them and this should be investigated and, where possible, removed by appropriate treatment.

(2) It is most desirable that juveniles be urged and assisted in their efforts to get right with those they

have wronged; even, if necessary, by working off their dues under Government supervision.

(3) In view of the sexual cause of much crime, the present methods of preparing young persons for the sexual life require revising, so as to safeguard the juvenile delinquent from those temptations to which he is particularly exposed.

CORRECTION.—In Dr. J. M. Fiallos's paper, published in *Journal of Tropical Medicine and Hygiene*, December 1, 1925, on "Castellani's Fermentation Phenomenon," the paragraph *B. typhosus* + *B. morgani* + *B. proteus* (p. 427) should read as follows: "*B. typhosus* alone produces acidity, never gas; *B. morgani* produces neither acidity nor gas; the mixture of the three germs produces gas."

A Comparison of the Khan with the Wassermann Test (Mildred H. Faupel, *Bulletin of the John Hopkins Hospital*, September, 1925).—The value of the Khan precipitation test for syphilis was studied in specimens of blood from 400 patients in comparison with the Wassermann test. Of these, 90·2 per cent. showed absolute agreement, 3·8 per cent. good relative agreement, 5 per cent. partial agreement, and 1 per cent. absolute disagreement. The co-efficient of correlation for the series was found to be 0·79. The method is comparatively simple and the reaction is completed within five to thirty minutes after mixing serum with antigen. The test is of especial help in cases in which the rapidity of obtaining results is an important factor. The test has not been found applicable to spinal fluids.

Lichenoid Sarcoid. An Unusual Case (Carroll S. Wright, M.D., *Archives of Dermatology and Syphilology*, September, 1925).—The case described in this paper presented a most unusual form of sarcoid; it appeared at first as areas of loss of pigment in which lichenoid plaques develop. The condition was associated with a pulmonary tuberculosis, which apparently developed four years after the appearance of the cutaneous manifestations. There still seems to be doubt as to the tuberculous nature of sarcoid. Until recently no one had reported the finding of the tubercle bacillus in sections of tissue from the nodules. In 1921 Kyrle was able to demonstrate the organism by staining in sections made from patches examined within ten days of their appearance. After this time they disappeared. Kyrle was unable to demonstrate the bacillus by animal inoculation. It was his opinion that the lesions were caused by foci of bacilli in the skin producing a focal reaction, the bacilli disappearing soon after the onset of the reaction. This work requires confirmation.

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MALTA FEVER AND INFECTIVE ABORTION.

AT a recent joint discussion of the Sections of Comparative Medicine, Obstetrics and Gynæcology and Tropical Diseases and Parasitology, at the Royal Society of Medicine, the subject dealt with was

Infective Abortion in Cattle and its Relation to Malta Fever.

In opening the discussion, Professor John Eyre pointed out that during the past decade a number of observations and experiments relating to *Bacillus abortus* on the one hand, and the organism which is regarded as the causative factor in the production of undulant or Mediterranean fever on the other, appear to indicate that the relationship existing between these bacteria is extremely close and suggest a new interpretation of results obtained by earlier workers. The trend of present-day opinion is to regard these two organisms as identical or so closely allied as to be included into one group or genus to which the name *Brucella* has been given.

Culturally, morphologically, and in their biochemical reactions the two organisms are indistinguishable, and attempts have been made to differentiate them by serological means, such as agglutination, complement-fixation and absorption tests. Eyre, however, while drawing attention to the tendency there was to make a diagnosis of identity upon serological grounds alone, contends that serological groupings are not all-important.

It was long considered that undulant fever was restricted to Malta and the Mediterranean littoral, so that Malta fever and Mediterranean fever were employed as synonyms for the disease. Further experience showed the malady to prevail far inland in Italy, France and Spain. It has also been recognized in India, Asia, Africa and America, and sporadic cases are also now being occasionally met with in England, so that the disease may now be considered world-wide in its distribution.

An ætiological study of the relationship between Malta fever and infective abortion produces somewhat conflicting results.

As long ago as 1911 it was shown that the *B. abortus* was present in a large percentage of samples of cow's milk submitted to guinea-pig inoculation and that the organism was excreted by the animal even when there was no obvious lesion of the udder. Soon afterwards the sera of some children were found to react positively with the *B. abortus*, and this may be correlated with the fact that children constitute the great proportion of the milk-drinking individuals in a community. It was then found that the milk of some London cows possessed the power of agglutinating laboratory cultures of *Micrococcus melitensis* and it is now believed that the agglutination is probably dependent upon the amount of infection of *B. abortus* present in the cows, and it seemed difficult to imagine that the English strain of this organism could be virulent for man.

The knowledge of these facts led to inquiries being made into the possibility of the infection of man by *B. abortus*, and it was shown that the serum of some individuals would agglutinate this organism in fairly high dilutions. Negative results, however, were obtained on injecting both men and monkeys intravenously with large doses of living *B. abortus* cultures. An investigation also into the complement-fixation reactions towards this organism in cases of abortion in women yielded completely negative results.

In some parts of Austria the contagious abortion of cattle is stated to be rife in districts in which undulant fever has not yet been observed in man. Further, pregnancy and Malta fever frequently coincide without abortion supervening, though lactation may be somewhat curtailed.

Careful recent work in Rhodesia, on the other hand, shows that in that country, and particularly in Southern Rhodesia, cases of undulant fever occur in men, women and children who cannot have become infected from goats, but who reside, or have resided, on farms or areas where cattle are, or have been, infected with the organisms causing infectious abortion. If this association can be verified in one country, it will undoubtedly be found to exist wherever these diseases are encountered. If, then, this insidious disease of cattle which is now known to be world-wide in its prevalence can, in any circumstances whatever, become infective to man, it is a matter of the greatest importance, and demands the most careful consideration. There are, however, still too many inconsistencies and discrepancies urgently calling for investigation, and many links must be added to the chain of evidence before we can give whole-hearted support to the view that *B. abortus* and *Micrococcus melitensis* are identical organisms, with all that the view connotes.

F. E. T.

Annotations.

Biological Investigation of California Rice Fields and Attendant Waters with Reference to Mosquito Breeding (W. C. Purdy, *Public Health Bulletin*, December, 1924).—Aside from the several findings which are stated, the two years' biological investigation in California presents one or two outstanding items of more interest than is usually accorded to routine results. The interest in the matter attaches partly because the information referred to is unexpected and out of the ordinary, and partly because of the human interest involved, the possible public health effects. The first item is the practical absence of mosquito breeding on the Nelson rice field. This fact was established by persistent and continuous collections during the entire rice-growing seasons of 1919 and 1920. Meantime, nearby puddles and ditches showed breeding, and, during the second season, when three additional rice and four additional ditches were included, all these showed breeding. The Nelson rice field alone stands out from all the other fields and related waters by reason of the radical difference it exhibits in that it practically fails to breed mosquitoes. This failure suggests the presence of some natural agency which operates to inhibit breeding. Such a natural agency would, it is needless to say, be a thing greatly to be desired. The second item is the apparent results of the search, during the second season, for the probable reason for lack of breeding in the Nelson field, an inquiry as to just what this natural inhibitive

agency might be. To this end a careful comparison of the Nelson field with all the other fields and puddles seems to indicate no considerable or essential difference in:

(1) Number of larval enemies.
(2) Relative amount of food supply.
(3) Temperature.
(4) Alkalinity of water.
(5) Free CO_2.
(6) Dissolved oxygen; or
(7) Relative stability.

The study of the alga growths, however, does reveal a difference which appears to be as fundamental and as well marked as is the contrast in breeding. The Nelson field contains a very heavy growth of a blue-green alga which is not found, except in rare instances and in very minute quantities, in any of the other fields or waters examined. Other algæ appear on the Nelson field in very small amount only. Moreover, this same blue-green (*Tolypothrix*) was similarly prevalent on the Nelson field in 1919. Further testimony concerning the apparently larvicidal effects in water containing this alga is furnished by the field tests and these effects seem potent not only for very young larvæ, but also for vigorous, half-grown ones; and, finally, the water in the feed canal (before coming in contact with this alga) is found to be favourable for larval development. Meantime, no explanation is yet available as to the manner in which the larvicidal agency acts. While definite conclusions may not safely be drawn from the field tests, which were carried out during one season only, yet it is permissible to say, pending further research, that there exists a possibility and even a probability that the lack of mosquito breeding on the Nelson rice field—in which matter it differs fundamentally from all the other waters examined—may be related in no small degree to the other outstanding difference which this same field exhibits, in that it contains a heavy growth of the blue-green alga *Tolypothrix*.

Radium Therapy in Dermatology (G. Allen Robinson, M.D., *American Journal of Roentgenology and Radium Therapy*, August, 1925).—In this paper the author gives his experiences with radium in the treatment of keloids, birthmarks, lupus erythematosus, verruca and epidermoid carcinoma of the skin. Keloids can be successfully treated by this method, but response to treatment varies with the size, thickness, consistency, rate of growth and duration. Recent, small, soft, rapidly-growing keloids in young subjects respond most quickly and with the best end-results. Surgical removal of large keloids, with post-operative irradiation to prevent recurrence, is suggested. Splendid results are obtained in the treatment of cavernous angioma and port wine marks, provided careful methods of radium application are used. The results of treatment of pigmented moles have not been satisfactory; cases of melanomata have responded well. Verrucæ are radio-sensitive and one treatment is generally sufficient to remove the lesions. Epidermoid carcinoma of the skin and lupus erythematosus are greatly benefited by radium treatment.

Leukoderma following Dermatitis Venenata (*Rhus toxicodendron*) (Lee McCarthy, M.D., and Lawrence K. McCafferty, M.D., *Archives of Dermatology and Syphilology*, September, 1925).—Kaposi first pointed out that leukoderma may follow various cutaneous eruptions. For many years syphilis has been accused of being the sole cause of this form of leukoderma, but a sufficient number of cases have been reported subsequent to psoriasis, parapsoriasis, pityriasis rosea, lichen planus, seborrhœic eczema, lichen simplex chronicus, &c., in order to dispel all doubt as to the non-specificity of leukoderma. The explanation of the production of this depigmentation is not clear in the case described in this paper as in those following the various diseases mentioned above. It is known, however, that leukoderma following syphilis, psoriasis, &c., originates on those lesions which have been but slightly infiltrated; such is the case in the lesions of dermatitis venenata. The question naturally arises whether one is dealing here with a true primary leukoderma due to a derangement of the pigment function of the skin areas invaded by the toxins of *Rhus toxicodendron*, or a pseudo-leukoderma resulting from exposure to the affected parts of the rays of the sun. Brandweiner believes that leukoderma following syphilis is due to a temporary derangement in function of the pigment-forming cells resulting from the action of the syphilitic virus. It seems plausible to believe that the toxins of *Rhus toxicodendron* could produce a similar disturbance in the function of the pigment-producing cells of the involved areas. The authors' belief is further strengthened when it is recalled that in their case the lesions of dermatitis venenata had completely healed ten days before exposure to the sun. Accordingly, it may be concluded that in the case described in this paper a true or primary leukoderma is being dealt with. Leukoderma has been repeatedly treated with Alpine light. In general the result has been disappointing. This form of treatment was resorted to in the case described. Five treatments were given at intervals of three weeks. A mild erythema over the involved area was produced at each visit. Judging from the amount of improvement which took place during a month it is believed that the achromia will be completely cured within a short time.

Observations on the Sigma Reaction for Syphilis (H. Everett Smiley, M.D., *Archives of Dermatology and Syphilology*, September, 1925).—From the results of the experiments described in this paper the

following conclusions may be drawn: The Sigma reaction offers a reliable index in following the effect of a course of treatment for syphilis. The validity of the Sigma reaction is apparently not affected by treatment. Much more information can be gained from a course of Sigma readings than from a similar course of Wassermann readings.

Immunological Reactions of the Isolated Carbohydrate and Protein of Pneumococcus (Oswald T. Avery, M.D., and Hugh J. Morgan, M.D., *The Journal of Experimental Medicine*, September 1, 1925).—Investigations have proved that the isolated carbohydrate of pneumococcus is non-antigenic in the sense of stimulating antibody formation. The isolated protein of pneumococcus is antigenic; it induces the formation of antibodies which react with nucleoprotein fractions of organisms of homologous and heterologous types. The antiprotein sera do not agglutinate type-specific strains of pneumococcus, or react with the carbohydrate derived from them.

The Antigenic Properties of Solutions of Pneumococcus (Oswald T. Avery, M.D., and James M. Neill, Ph.D., *Journal of Experimental Medicine*, September 1, 1925).—It is found that intact pneumococci, possessing specific antigenic powers unimpaired by cultural or other procedures, give rise to agglutinins for organisms of the homologous type and to precipitins for the type-specific carbohydrate derived from them. Solutions of pneumococci free of all formed elements, but containing the carbohydrate and protein of the original cell, fail to stimulate the formation of type specific antibodies. Sera prepared in this manner do not react with the carbohydrate constituent of the cell and do not agglutinate organisms of the homologous type. The loss of this antigenic function is related to changes incurred during dissolution of the bacterial cell. Solutions of the cellular substances of pneumococcus, although lacking the specific antigen of the whole cell, induce the formation of antibodies reactive with pneumococcus protein regardless of the type from which the latter is derived.

Cause of Nitritoid Crisis following Intravenous Injection of Arsenicals (Ernest Friedrich Müller, M.D., *Archives of Dermatology and Syphilology*, September, 1925).—It was observed that the patients who reacted to arsphenamin with unusual symptoms of a nitritoid crisis and those who showed equally unusual symptoms after injections of silver arsphenamin, i.e., a decrease in the number of leukocytes in the blood with or without visible manifestation, will also react positively to the Widal test without showing any apparent sign of hepatic involvement. Following the studies described in this paper on the causes of Widal's hæmoclastic crisis and entirely independent of any possible hepatic involvement which would entail an abnormal condition of the involuntary nervous system, it must be assumed that in the seven patients with a positive reaction, even the simple act of taking nourishment leads to an abnormal reaction of the leukocytes and of the involuntary nervous system. The fact of the presence of the Widal hæmoclastic crisis is proof that abnormal conditions exist in these patients. This confirms former conclusions that the unusual reaction in the blood following injections of silver arsphenamin into patients who also show symptoms of a nitritoid crisis after administration of arsphenamin is not due to the drug, but rather to a pathological reactivity of the involuntary nervous system. This abnormal reactivity, latent in the body before injection and manifested by an unusual reaction of the body itself, is due to a disturbance of the involuntary nervous system.

The Wassermann Test. XV.—The Effect of Bismuth on the Wassermann Reaction in Patients Unresponsive to Arsphenamin (Archives of Dermatology and Syphilology, September, 1925).—It is found that bismuth lowers the strength of the Wassermann antibody not only in patients who are responsive to arsphenamin, but also in those who are unresponsive. The average reduction in this series, composed largely of arsphenamin-resistant patients, was 39 per cent., which probably represents the minimum effect of bismuth. Nine-tenths of the reduction was obtained four weeks after the end of treatment, and the remaining one-tenth by the sixteenth week. In patients with old syphilis bismuth does not give any slower serologic action than the arsphenamins. The reduction would appear to be permanent, at least it was found to be permanent for the six months the patients were under observation. The few patients who showed a relapse received less than the standard dosage.

Variable factors, such as the strength of the reaction, the clinical stage and duration of the disease and the total dosage, which usually render serologic interpretations of doubtful value, exerted a negligible influence in this particular series and permitted direct comparison between patients responsive and unresponsive to arsphenamin. However, the extent of the reduction of the Wassermann antibody corresponded to the intensity of treatment. All the Wassermann-fast patients in this series had shown no change in the strength of the Wassermann antibody under treatment with arsphenamin. One-half of these patients reacted to bismuth as compared with five-sixths of the patients who were responsive to arsphenamin. Also the quantitative reduction of the Wassermann antibody in these patients was one-half of that of the arsphenamin responsive patients. After the first course of treatment the total amount of arsphenamin and mercury administered had no apparent influence on the action of bismuth.

Chemotherapeutic Experiments with Chaulmoogra and Allied Preparations (Otto Schobl, *Philippine Journal of Science*, April, 1924).—No disinfecting effect was shown upon acid-fast bacteria by the vapours of chaulmoogra and *Hydnocarpus* oils, but the volatile constituents of certain essential oils show high disinfecting activity with a strong indication of selectivity toward acid-fast bacteria.

The Preparation of Endo's Medium (Norman MacL. Harris, *Military Surgeon*, September, 1925).—The author is of the opinion that the following factors produce a satisfactory Endo medium. As a basis, Levine's formula, which does away with one of the root troubles, namely, meat extract. A basic fuchsin containing both rosaniline and pararosaniline; other fuchsins are productive of irregular results. A hydrogen-ion concentration within the limits of pH 7·4 to 7·6. Any peptone that will give with Levine's formula a vigorous growth; "Difco" is highly recommended.

Diabetic Retinitis (Harry Friedenwald, M.D., *Journal of the American Medical Association*, August 8, 1925).—Diabetic patients developing retinitis generally present the punctate form which is most marked in the region between the superior and inferior temporal vessels, but may extend to other parts of the retina. The spots are usually small, but may coalesce into lines or even large masses. They are usually accompanied by fine hæmorrhages. The optic discs are of clear outline; there are no signs of retinal œdema, and ill-defined "cotton-wool" spots are rarely found. Other conditions—thrombosis of the retinal vein, retinitis proliferans and profuse hæmorrhages — are of rare occurrence. Retinitis punctata centralis was found in thirty-three cases with diabetes, and in eighteen without diabetes, of which latter nine showed evidences of nephritis. At most only nine cases could therefore be certainly classified as arterio-sclerotic retinitis. The view of Foster Moore, that this form of retinitis is primarily due to arterio-sclerosis, would lead us to expect to find it frequently, much more frequently without diabetes than with it, because of the vastly greater number of arterio-sclerotic patients who are free from diabetes than those who suffer from it. But as seen in the series described in this paper, quite the opposite is the case, diabetes being found almost twice as often as absent. Nor does this take account of the fact that the cases classed as "non-diabetic" were not examined as to blood-sugar, and in many of the cases a single examination had to suffice. Hirschberg and others have found retinitis punctata centralis in cases in which no sugar was found at the first examination, and it required repeated examinations to discover it. Again, this does not take into account the well-known fact that in old cases of diabetes traces of sugar may be lost after nephritis has become established. The view is justified, therefore, that retinitis punctata centralis, whilst not pathognomonic of diabetes, is indicative of this ætiologic basis. When found in the presence of diabetes, or even of diabetes with nephritis, it may with propriety be designated as diabetic retinitis. Others have stressed the appearance of profuse retinal hæmorrhages in diabetes. The foregoing cases do not bear this out. The retinal hæmorrhages found are generally punctate. Abundant hæmorrhages are rare.

Parenchymal Râles in Pulmonary Tuberculosis (E. H. Bruns, M.D., *Journal of the American Medical Association*, September 5, 1925).—Showers of fine and medium râles of equal size, occurring at the end of a full inspiration, or the so-called coughing râles which occur when the patient forcibly breathes out, gives an expiratory cough and immediately breathes in, are not due to the bubbling of secretions in the alveoli or bronchial tubes, nor are they necessarily associated with abnormal secretions in these structures. Such râles are not always associated with active inflammatory processes in the pulmonary parenchyma or bronchi, and must be distinguished from tracheal, bronchial, cavity and pleural râles. Parenchymal râles cause the most confusion. They may be due to pneumonia, fibrosis, atelectasis, pleurisy, &c., and cannot be said to be associated with any particular disease or pathologic condition. Showers of râles usually elicited only by cough and heard over the upper parts of the lungs are unquestionably the most reliable physical sign for the detection of tuberculous lesions. The significance of these râles as a criterion of manifest tuberculosis and the character of the lesions will depend on other clinical findings —history, symptoms, sputum, roentgen-ray examination. A period of observation may be necessary in order to arrive at a definite diagnosis. In studying the progress of a case and in deciding whether a tuberculous process is progressing or undergoing retrograde changes, the persistent occurrence of this type of râle is not a conclusive sign unless correlated with other physical signs and clinical findings.

Argentine Tumours of the Appendix and Small Intestine (Wiley D. Forbus, M.D., *Bulletin of the Johns Hopkins Hospital*, August, 1925).—Attention is called to the fact that the term "carcinoma" has been erroneously applied to a group of small tumours occurring either singly or in numbers in the appendix and small intestine, and which bear a morphological similarity to true carcinoma of these organs. In six cases of so-called "carcinoma" of the appendix and small intestine, the argentaffine or chromaffine character of the cells of these tumours, originally described by Gosset and Masson, have been confirmed. The "car-

cinomas " or " carcinoids " of the appendix and small intestine have their origin in the cells of Kultschitzky and Schmidt of the crypts of Lieberkuhn and, therefore, are tumours of the chromaffine system. They may be spoken of as argentaffine tumours, in view of the peculiar ability of the granules of the tumour cells to reduce an ammoniacal solution of silver. The importance of differentiation between the argentaffine tumours and a peculiar form of adenocarcinoma of the appendix and small intestine, which is superficially similar to the argentaffine tumours, is emphasized. Attention is called to the general harmless character of the argentaffine tumours.

Studies on the Relation of Insect Herpetomonad and Crithidial Flagellates to Leishmaniasis. 1.—*Inoculation of Mammals with Insect Flagellates* (Jaroslav J. Drbohlav, M.D., *American Journal of Hygiene*, September, 1925).—The inoculation of *Herpetomonas ctenocephali* of the dog-flea, from both old and freshly isolated cultures, into warm- and cold-blooded animals, i.e., mouse, rat, rabbit, dog, monkey and frog, has invariably proved unsuccessful. The flagellates inoculated became rounded in about one hour and then degenerated and diminished in number, so that after six hours very few were present. No forms were found after twenty-four hours. Up to three hours after inoculation the flagellates could usually be recovered in culture. Material from the water strider, *Gerris remigis*, infected with *Crithidia gerridis*, was inoculated into mice, rats and frogs without success. No forms were found in preparations or recovered in cultures from animals examined at intervals of from 1 to 150 days. The inoculated flagellates disappeared after six hours. *Herpetomonas muscarum*, from the gut of flies of the genus *Lucilia* and from freshly isolated cultures, was inoculated into mice, rats and frogs without producing infection. The same monkey used for the inoculation of flea flagellates was inoculated subcutaneously, with negative results. Several species of plants of the genus *Euphorbia*, found in the Botanical Gardens in Cambridge, Mass., and one species of *Asclepias* growing abundantly in the vicinity of Boston, were all found free from flagellates. In hanging-drop preparations of latex from these Euphorbiaceæ inoculated with *Herpetomonas ctenocephali*, *H. muscarum*, *Leishmania infantum*, and *Trypanosoma rotatorium*, motile forms were present after a period of five days, but no multiplication took place. All the forms degenerated and were dead after six days. The Euphorbiæ were inoculated with different cultures of herpetomonad flagellates, but no forms were found in the latex, although examined daily for a period of thirty-five days. In none of the animals and plants inoculated was there any indication of multiplication of the flagellates within the body, but on the contrary these diminished in number and disappeared after a few hours. The positive results reported by others may be explained by a confusion of natural infections for the inoculated, especially since proof, such as might be obtained by isolation in culture of the flagellate inoculated is lacking. The author's experiments would indicate no ætiological relationship existing between the insect herpetomonads, *H. ctenocephali*, *H. muscarum*, and *C. gerridis*, and Leishmaniasis, and the author's results confirm those obtained by American and the majority of European investigators.

Studies on the Relation of Insect Herpetomonad Flagellates to Leishmaniasis. II. *The Specificity of the Various Insect Flagellates for Certain Hosts, as indicated by Cross-Infection Experiments* (Jaroslav J. Drbohlav, M.D., *American Journal of Hygiene*, September, 1925).—Cross-infection experiments show that fleas may be artificially infected with their natural parasite, *Herpetomonas ctenocephali*, but not with *Leishmania infantum*, *Herpetomonas muscarum* or *Crithidia gerridis*. Larvæ of the dog-flea, *Ctenocephalus canis*, were artificially infected by feeding them with fæces of infected fleas and with cultures of *H. ctenocephali*. Since such infected larvæ remained infected throughout the entire larval, pupal and adult stages of development, it appears probable that the natural infection of fleas is acquired in the larval stage by feeding on infected fæces of adult fleas, and not in the adult stage when only animal blood is taken as food. Attempts to infect flagellate-free *Gerris remigis* with *H. ctenocephali*, *H. muscarum* or *L. infantum* proved unsuccessful. Attempts to infect clean flies by feeding them the *H. ctenocephali*, *L. infantum* and *C. gerridis* failed. Cross-infection experiments carried out with cultures of *H. muscarum* on certain species of flies of the genera *Musca*, *Fannia* and *Lucilia* have furnished positive results, all of these species serving as suitable hosts. This, in the absence of any other differential character, indicates that the flagellates described as different species from these various flies represent one and the same organism. Therefore the name *Herpetomonas muscarum* applies to herpetomonads found in different species of flies.

Studies on the Relation of Insect Flagellates to Leishmaniasis. III.—*Cultivation Requirements* (Jaroslav J. Drbohlav, M.D., *American Journal of Hygiene*, September, 1925).—Experiments to determine the growth requirements of different flagellates have shown that the pH concentration of medium is a very important factor in the cultivation. The flea flagellate gave the maximum growth at a pH of 6·8, whereas the fly flagellate grew best at pH 5·4 to 5·6. The best culture of *Leishmania* was obtained at 7·0. The parasites showed also some variations in form upon media with different reaction. In the case of *Herpetomonas ctenocephali*, characteristic twisted forms were abundant at pH 5·6 to 6·2, whereas in higher concentra-

tions shorter forms, with few or no twists, were present.

From the experiences of the present study of different constituents of media used for cultivation of herpetomonad flagellates, a slight modification in preparing media and handling cultures is given. On such media all strains of herpetomonad flagellates used in the present investigations were readily kept for the period of one year without transfer; successful subcultures were obtained.

The Penetration of Fruits and Vegetables by Bacteria and Other Particulate Matter and the Resistance of Bacteria, Protozoan Cysts and Helminth Ova to Common Disinfection Methods (Ralph G. Mills, M.D.; Clifford L. Bartlett, M.D., and John F. Kessel, Ph.D., *American Journal of Hygiene*, September, 1925).—It is found that normal uninjured fruits and vegetables do not contain living bacteria within their tissues. Finely divided particulate matter, such as carbon, corresponding in size to bacteria, protozoan cysts and helminth ova, does not penetrate the stem-end of fresh vegetables to any appreciable extent. Bacteria do not penetrate the unbroken skins of fruits and vegetables, kept under market conditions. Bacteria pathogenic to man may gain entrance to fruits and vegetables through injured and decayed portions, where they may spread to a very limited extent, and may remain alive for seven to forty-two days. They may also contaminate the cut-end of vegetables and remain viable for a similar length of time. It is, therefore, advisable to remove such portions before attempting sterilization. Pathogenic bacteria may persist on the surface of fruits and vegetables kept under moist conditions, for fifteen days or more. The gradual loss of moisture through the covering of fruits and vegetables would tend to keep them viable longer than would be possible on perfectly dry surfaces. When such food-stuffs are freshened with water, the viability would be influenced by the saprophytic flora normal to such an environment. Chlorination freed the surface of vegetable matter from pathogenic bacteria in every instance, but was not effective against cysts or ova. Alcohol is ineffective in killing all protozoan cysts and helminth ova in sufficiently short periods of time to make it valuable as a disinfecting agent. Potassium permanganate in the concentrations ordinarily used is not an effective disinfectant against helminth ova and protozoan cysts.

Burning alcohol on the surface of fruits and vegetables, or pouring boiling water over them does not destroy all pathogenic organisms, either bacteria, cysts or ova. The heat does not sufficiently penetrate the crevices. Dipping fruits and vegetables for ten seconds into boiling water or water which remains above 80° C. during the immersion, is the only method thus far discovered which will uniformly kill all pathogenic bacteria, protozoan cysts, and helminth eggs which might be found contaminating such food-products, and render them safe for human consumption in an uncooked condition.

Roentgen-Ray Treatment in Bronchial Asthma and Chronic Bronchitis (Issac Gerber, M.D., *Journal of the American Medical Association*, October 3, 1925).—It is found that many cases of true bronchial asthma do not respond to the removal of supposed extrinsic causes or to specific therapy, even though careful sensitization tests have been made. A large proportion of these patients may be markedly benefited by careful Roentgen-ray treatment. In favourable cases there is a lessening, and even disappearance, of the paroxysms and cough, a change in the amount and character of the sputum and a diminution of the abnormal microscopical elements in the sputum. Two types of Roentgen-ray applications are used, one directed to the mediastinum and chest, and the other to the spleen. The mediastinal treatment probably has its effect, though a shrinking action on the rays on the enlarged tracheo-bronchial and mediastinal lymph nodes, with subsequent diminution in the irritability of the local fibres of the vagus nerve. The mechanism of the effect through splenic exposure is not so clear, but may possibly be concerned with the release of antibodies which modify the anaphylactic seizure. Chronic bronchitis without asthmatic attacks can also frequently be helped by application of Roentgen rays to the mediastinum. The most favourable results are obtained in younger people, particularly in children who have persistent coughs after attacks of grip or pertussis. Cases of secondary bronchiectasis that are not of surgical extent may be improved when other treatment is ineffective.

Study of a Hemolytic Proteus Bacillus (B. S. Kline, *American Journal of Hygiene*, September, 1925).—A proteus bacillus, highly pathogenic for rabbits, was isolated forty-eight hours post mortem from human bone-marrow. The organism grows well on ordinary media, has a fairly characteristic sugar reaction and unusually great hæmolytic power. The blood-picture was followed in eighteen inoculated animals, smears showing the appearance in the circulation of a moderate number of nucleated red blood-cells, usually within forty-eight hours. Megaloblasts, also in moderate numbers, were occasionally observed. Animals inoculated with repeated, increasing doses of the organism, over a period of a few weeks, developed a siderosis, more marked in the spleen and bone-marrow, moderate in the liver. A hyperplastic bone-marrow was found in the majority of the inoculated animals.

Proteus Hæmotoxin (E. E. Cker and H. H. Brittingham, *American Journal of Hygiene*, September, 1925).—The hæmotoxin of a culture of *Proteus* isolated from human bone-marrow was studied. The hæmotoxin was produced in broth

and synthetic medium cultures. The toxin rapidly hæmolysed human, sheep, dog; cat, guinea-pig and rat erythrocytes. Chicken erythrocytes were less rapidly attacked. The production of *Proteus* hæmotoxin varied greatly with the strain employed. The lytic principle was independent of the life of the organism. The organisms were killed by etherization. The cultures remained toxic after cell death. The lytic principle was retained in the filtrate of cultures passed through a Berkefeld candle. This observation is not in agreement with the finding of Braun and Chao Shi-Tsing, who found no hæmotoxic effect following Berkefeld filtration or destruction of the cultures. These authors believe that the hæmotoxin is a constituent of the ectoplasm of the organism and firmly bound to the organism. They claim that non-ciliated *Proteus* bacilli have no hæmolytic capacity. We found the hæmotoxin to be thermolabile. Even as low a temperature as 37° C. weakened it. At 45° C. its power was greatly reduced, and at 55° C. it was completely destroyed. We failed to obtain a "Koch-gift," as demonstrated by Bach, although the author himself claimed the phenomenon to be variable. Witte peptone in certain concentrations inhibited the reaction, a fact also recently demonstrated by Bach. Ultra-violet light greatly retarded its power, depending on distance and length of exposure. Anti-hæmotoxic (rabbit) serums demonstrated a definite neutralizing power if the serum and toxin were first mixed and the cells then added to them. Under similar conditions normal rabbit-serums failed to protect. These anti-hæmotoxic serums did not protect against the action of tetanolysin. During the course of the experiments it was found that an optimum concentration of the serum was necessary, a fact also demonstrated by Braun and Chao Shi-Tsing.

Pyrubrin, a Red Water-Soluble Pigment characteristic of Bacillus pyocyaneus (Percy Davol Meader, Ph.D.; George H. Robinson, Ph.D., and Veader Leonard, M.D., *American Journal of Hygiene*, September, 1925).—All typical strains of *B. pyocyaneus* produce three water-soluble pigments: (*a*) the *fluorescent pigment*, which is yellow by transmitted light and green by reflected light; (*b*) *Pyocyanin*, which is bright blue; (*c*) *Pyorubrin*, which is bright red. The fluorescent pigment is non-specific. Pyocyanin is specific of *B. pyocyaneus*. Pyorubrin is characteristic of *B. pyocyaneus*. Each of these three pigments is derived by oxidation of a specific leuco-base which is formed anaerobically. Each of these three pigments will yield its specific leuco-base on reduction with zinc and hydrochloric acid, while oxidation of the colourless compound thus obtained invariably yields the pigment from which it was derived. Pyocyanin and the fluorescent pigment are indicators. Pyorubrin remains unaffected in colour when treated with acid or alkali. The majority of strains of fluorescent organisms derived from Nature, and which are culturally identical with *B. pyocyaneus*, will produce both pyocyanin and pyorubrin on appropriate media and should therefore be classified as *B. pyocyaneus*. Typical strains of *B. pyocyaneus freshly* isolated from human lesions invariably produce both pyocyanin and pyorubrin in abundance and may be highly virulent, while strains isolated from the environment and old laboratory strains may lose temporarily their power to produce any but the fluorescent pigment, and at the same time become avirulent. Agglutination and absorption tests have failed to reveal any difference among the various strains examined. Virulent strains of *B. pyocyaneus* exhibit a pronounced selective affinity for the genito-urinary organs of laboratory animals.

Comparative Studies of the Action on the Pneumococcus of Bile-Acids and Unsaturated Fatty Acids, found in Bile in the Form of Soaps (Anthony Kozlowski, Ph.D., *Journal of Experimental Medicine*, October, 1925).—Ox-bile contains the soaps of unsaturated fatty acids not only with one, but also with two and more than two double bonds, in a dilution of about 1:600. These substances, when isolated from bile, exert an antiseptic action on the pneumococcus in a dilution of approximately 1:50000, and kill the organism in a dilution of 1:5000 in approximately one hour. As their action is, then, about one hundred times stronger than that of the conjugated bile-acids, their presence in bile should be considered, whereas hitherto it has been entirely overlooked not only by bacteriologists, but by physiologists as well. Since the soaps of unsaturated fatty acids do dissolve the pneumococcus cell in broth culture, Neufeld's conclusion is no longer valid.

The Production of Persistent Alopecia in Rabbits by X-rays of Various Degrees of Hardness (Harry Clarke, Ph.D., and Ernest Sturm, *Journal of Experimental Medicine*, October 1, 1925).—The minimum dose of X-ray, of each of three degrees of hardness, required to produce persistent alopecia of the abdominal skin of normal white rabbits has been studied. 40-kilowat rays filtered by 0·5 mm., 50-kilowat rays filtered by 1 mm., and 70-kilowat rays filtered by 1·5 mm. of aluminium were employed. The 70-kilowat work is unfinished.

Local Immunization of Rabbits to Cutaneous Infection with Staphylococcus Infection (Tracy B. Mallory, M.D., and Alexander Marble, *Journal of Experimental Medicine*, October, 1925).—Bacterial filtrates prepared by the methods described by Besredka did not develop any specific growth-inhibiting factors. Such filtrates produced strictly local immunity of the areas of the skin infiltrated, but such protection was never greater than that produced with the broth from which they were prepared. This immunity was manifest in eight hours and persisted at fifteen days. Transcutaneous treatment by moist dressings soaked in either filtrate or broth were entirely ineffective. Sites of healed

cutaneous lesions show a strictly local and non-specific immunity for a period of five to six weeks. Repeated intracutaneous infection with virulent staphylococci failed to produce a general cutaneous immunity.

Inguinale Hernia: Report of 100 Operations on Korean Patients (A. I. Ludlow, *China Medical Journal*, March, 1925).—This is apparently the first report of hernia in Koreans, but the disease has existed in the country for centuries, according to the Chinese medical books. As yet, no accurate statements can be made with regard to the frequency of hernia in Korea, but it is probably of frequent occurrence. All the patients were Korean males, the youngest at time of operation being two years of age and the oldest 84 years. The acquired hernias varied in their duration from four days to forty-five years, with an average of ten years. There were twelve congenital hernias (found at birth) and eighty-eight acquired hernias (developed after birth). Right hernia was more frequent than left. Strangulation was present in twelve cases. With regard to intestinal parasites in these hernia cases, *Trichuris* was found sixty-five times; *Ascaris* fifty-three; *Ankylostoma* ten times, and *Tænia* in one case. Examination of the sputum showed ova of *Paragonimus westermanii* in twenty cases; *B. tuberculosis* in one case.

A Survey of Human Intestinal Protozoa in Peking, China (J. F. Kessel and R. Svensson, *China Medical Journal*, December, 1924).—During six months fæces-smears from 1,037 individuals were examined; of these 816 were Chinese and the rest were resident foreigners. Among the Chinese, infestations with intestinal protozoa showed the following percentages: *Entamœba nana*, 40·1; *E. dysenteriæ* (=*histolytica*), 29·5; "*Councilmania lafleuri*" 19·2; *E. coli*, 11·7; *Iodamœba bütschlii*, 13·0; *Giardia intestinalis*, 10·0; *Chilomastix mesnili*, 6·0; *Trichomonas hominis*, 4·5. Among the foreigners in Peking the percentages were as follows: *E. nana*, 26·5; *E. dysenteriæ*, 16·5; "*Councilmania*," 14·5; *E. coli*, 11·6; *Iodamœba*, 3·2; *Giardia*, 3·0; *Chilomastix*, 10·0; *Trichomonas*, 2·8. The percentage of infestations with *E. dysenteriæ* amongst Chinese adults was 32·5, and among Chinese children 25·3; and the infestations among foreigners were 25·0 and 1·7 respectively.

Contribution to the Study of the Biology of Anopheles superpictus (B. Grassi, *Rendiconti della R. Accademia Nazionale dei Lincei*, Rome, June, 1925).—*Anopheles superpictus* is present in nearly every part of Italy, but is most frequently found in the south. It is most numerous during the months of July and August, while *A. claviger* is most numerous during May and June. *A. superpictus* was first found in October, 1922, at Sangiovanni Incarico, near Ceprano, where it exists in large numbers. Its chief locality is Saluzzo, chiefly in stables. Like *A. claviger*, these parasites are to be found on walls, ceilings and almost anywhere. The eggs are deposited in lines and are thus easy to count; they are smaller than those of *A. claviger* and *do not present the air spaces which are the general characteristic of anopheles*. The larvæ of *A. superpictus* greatly resemble the description of Edwards with the exception of a few minor details.

Current Literature.

THE AMERICAN JOURNAL OF TROPICAL MEDICINE. July, 1925, and September, 1925. Vol. V.

The Basal Metabolism of a Normal Young Man as affected by a Tropical Residence of One Year (W. D. Fleming).—In this paper the author presents data on the metabolism of a normal white man, 22 years old, seven months after his arrival in Manila and, again, after an interval of thirteen months. The man underwent numerous laboratory tests and physical examinations, and the only abnormality found at any time was a marked degree of astigmatism in one eye. His habits and mode of life were normal and regular both in the States and in the Tropics. For the first series the basal metabolic rate averaged 3 per cent. minus, for the second series 7 per cent. minus.

Hookworm in Palestine (A. Felix).—These investigations were carried out early in 1922. The first published observation of hookworm in Palestine was made by Muhlens in 1913, but the case was not an indigenous infection, it was imported from America. Dr. Goldberg observed four or five cases among Arabs during 1912 and 1914, but the origin of the infection was not determined. It has been the intention of the author to investigate the existence of endemicity of hookworm disease in Palestine. Petach-Tikvah was the colony chosen for investigation, being the largest (5,000 inhabitants) and also because the inhabitants had for a longer period than any other colony engaged in the intensive cultivation of oranges, which require continual artificial irrigation. Results proved that Petach-Tikvah is an endemic centre of hookworm, a fact which has hitherto been overlooked, and cases which have occurred have possibly been misdiagnosed. Further investigations in 1924 confirmed those of 1922. The disease has probably been imported from Egypt, but the fact that large numbers of Indian and Egyptian soldiers were employed in Palestine during the war must be borne in mind. With the advance of agriculture, which will necessitate constant irrigation on a large scale, favourable conditions for the spread

of hookworm will be created in various parts of the country.

Blood-Serum Globulin in Leprosy (Chester N. Frazier and Hsien Wu).—The results in this series of cases indicate that Sia's globulin precipitation is positive in certain cases of leprosy, particularly in the nodular and mixed types of the disease. Of the thirty-two cases of leprosy on which this test was made seventeen of them were positive. The intensity of the reactions varied from one to three plus. In all of these cases the percentage of blood-serum globulin was estimated. The nodular cases showed an average of 4·68 per cent.; the mixed cases 4·52 per cent.; the active maculo-anæsthetic cases 4·23 per cent., and the latent maculo-anæsthetic cases an average of 3·11 per cent. The value of the test from a diagnostic point of view in the differentiation of kala-azar and schistosomiasis from leprosy is not of importance. Although the three diseases are often found endemic in the same regions, the clinical differences between the former diseases and leprosy are sufficiently distinct to prevent any confusion in their differential diagnosis.

It is impossible to see any relationship between the serum globulin content of the blood of the cases treated with the ethyl esters of chaulmoogra oil, and those not treated, sufficient to make it of any value as a clinical test for determining the efficacy of such treatment. It is suggested, however, that the blood-serum globulin and the precipitation test be studied in this relation to ascertain whether or not there is any decrease in the amount of serum globulin or the positiveness of the test parallel with clinical improvement. Although the serum globulin of leprosy does not reach the height it does in kala-azar and schistosomiasis, the total protein content exceeds that of these two diseases because of the behaviour of the serum albumin.

The Occurrence of Spirochæte-like Filaments in the Blood of Dengue Patients and in Normal Individuals (M. W. Hall).—Attention is recalled to the existence in the blood of motile filamentous elements, highly suggestive of living organisms. They occur in normal blood as well as in various pathological conditions. It is suggested that some at least of the forms described by Couvy and by Verwoort from dengue and allied fevers may well be of this type. Incidentally, the same may be said of the spirochætes described by Blanchard and Lefrou in the blood of blackwater fever. The use of the iron hæmatoxylin stain of Heidenhain after wet fixation in Bouin's fluid affords a means of distinguishing these spirals from true living organisms, although their differentiation from any forms known at present should not be difficult under the dark-field once the existence of these forms is taken into consideration. Some evidence has been adduced in support of the opinion that the platelets rather than the red cells are the main source of these filaments.

The Leprosy Problem in the Philippine Islands (G. R. Callender).—In this paper is pointed out the great amount of good done by the compulsory segregation of lepers in the Philippines. Compulsory segregation dates from 1906, when the leper colony at Culion was established. Prior to segregation cases of advanced and disfigured leprosy were frequently seen on the streets, even among labourers and employees in all occupations, to-day only those in the early stages of the disease are picked up. This latter fact attests to the value of segregation, but the desired result is still far from reached, and the Philippine Government is making extraordinary efforts to cure leprosy and determine the most efficient remedial methods towards this end.

The inauguration in 1921 by Governor-General L. Wood of the intensive treatment of all lepers segregated has been the largest experiment in the treatment of this disease, or any other, yet undertaken, and the excellent results obtained prove the value of this method. There is one condition in the colony at Culion with which the authorities thus far have been unable to cope, and that concerns the children of the lepers. It was attempted to separate the children from their infected parents, but it was found impossible, with the facilities available, to save the children.

Amœbic Abscess of the Liver (Ward J. MacNeal and Paul Klemperer).—A case is presented of amœbic dysentery with complicating liver abscess and fatal termination, fairly typical in clinical history and course, but which was not recognized until the autopsy. The disease was apparently contracted in New York City. From the ulcers the protozoa, *Endamœba dysenteriæ*, penetrated into the veins and were evidently transported through the blood-stream to the liver. Here an amœbic abscess was produced, which discharged amœbæ and eventually pus into the hepatic veins and the inferior vena cava to reach the lung capillaries through the pulmonary arteries. The bacterial infection was evidently secondary and of little importance until late in the disease. The authors suggest that for the identification of the parasites in unusual locations several staining methods should be employed to avoid mistake.

Mosquito Repellents (C. W. O. Bunker and A. D. Hirschfelder).—A systematic study has been made of a large series of definite organic compounds, to obtain data upon the relative repellent effects of a series embracing the simple hydro-carbons, the alcohols, aldehydes, ketones, ethers, esters and phenols, in order to determine whether repellent action is associated with the presence of any one definite organic radical or whether it is associated with any definite physical characteristic such as boiling point, &c. The experiments were made on the arms of human subjects, and at a time when mosquitoes were abundant. The results are tabulated; they certainly indicate a repellent effect of greater or less degree for most of the substances tested. To certain ones the mosquito would appear to be indifferent, if not actually attracted by them, for example, heptane, xylol, naphthalene, phenetol and benzyl benzoate.

Colonial Medical Reports.—No. 169.—Calcutta (*contd.*)

A coagulent is necessary—therefore alum is the one commonly used and has the formula— $Al_2(SO_4)_3$.

Alum combines with the alkali in the water forming $Al(OH)_3$, hydrate of alumina, a gelatinous substance which in falling entangles small particles in Group 1 and 2, making the proportion in Group 1, much larger and therefore hastening clarification by gravity settlement. But it has an important action on Group 3. A certain amount of alum, $Al_2(SO_4)_3$ probably becomes in water dissociated into hydrate of alumina and sulphuric acid. The result of this is that a large number of positively charged ions such as hydrogen and aluminium are freed and these neutralize the negative charges on the colloidal particles which then coalesce forming larger particles which are enmeshed by the aluminium hydrate already formed and therefore now fall into Group 2, and possibly Group 1, being deposited gradually by gravity. If sufficient alum is not added it is easily seen how the clarification will be incomplete, much of the colloidal matter remaining unacted on. Alum is the most commonly used substance for the purpose of dealing with colloidal matter; and is probably as effective as any yet known. More work on these electric colloids derived from clay is required to find some cheap practical and effective method of neutralizing their charges and depositing the particles. To form the hydrate of alumina, alkali in the water is required. I think it has been found that there is unusually enough alkalinity in the Hooghly water to act with the amount of alum necessary for clarification; I have not found that the addition of small quantities of lime is of any assistance in clarification of Hooghly water by alum. Further, if the settlement arrangements are not sufficient or are faulty, the water passing into the filter beds will not be sufficiently clarified. It is a well-known fact that slow sand filter beds cannot deal effectively with turbid water, the deposited mud interfering with the straining powers of the filterng layer. If there is much colloidal matter in a water we know that simultaneously the amount of particles of Group 2 will also be much increased. If the settlement is not satisfactory these Group 2 particles pass over on to the sand filter which will then not act as efficiently as before, possibly allowing more bacteria to pass through.

The following conclusions may therefore be stated:—

(1) The presence of colloidal matter derived from clay sources in a filtered water is not of itself harmful.

(2) Its presence in a filtered water, however, may indicate:—

(a) That sufficient alum is not being added to produce coagulation and clarification.

(b) That the increase in the amount of fine suspended matter (Group 2) may possibly not have been dealt with efficiently by coagulation and sedimentation and the efficiency of the slow sand filter may have been reduced by this and consequently the bacterial quality of the water may have deteriorated. Whether this is so or not can be determined by any deterioration in the results of bacteriological examination.

During the first days when this particular quality of water was coming down it is possible that an insufficient quantity of alum was being added to the raw water. By courtesy of Dr. Crake and Mr. Wilson I was privileged to go round the Pulta Works. As Mr. Wilson has pointed out, the settlement arrangements are not quite satisfactory. The length of time allowed is probably not long enough and the mode of connection between the tanks is open to criticism. These connections produce noticeable swirls and eddies and, as pointed out above, these eddies and currents will undo in a few seconds all the good that has been done by hours of previous quiet settlement. A brief consideration of the source of this colloidal clay may help in the study of the problem.

The Ganges water up country in the United Provinces, for instance, in the rains, contains much suspended matter but a very small proportion is colloidal. On the other hand the waters of the rivers coming from the districts of Chota Nagpur in Behar and Orissa, when in flood, contain much colloidal clay brought from the hills. The source is probably the laterite deposits. At Burdwan, for instance, which draws its water supply from the Damodar River, the problem is a yearly one. There are other rivers, e.g., the Ojay, which comes from Behar and Orissa and flows into the Hooghly north of Burdwan. There is also a canal, I believe, connecting the Damodar and the Hooghly. The opalescent matter, then, comes from Chota Nagpur districts and not from up-country. If the Ganges, as a whole, is small and there is a big flood in Chota Nagpur only, the Behar and Orissa rivers will bring down large quantities of fine matter and will form a large bulk of the Hooghly water. This in a few days will arrive in Calcutta and give trouble. This is what happened this year. A big burst of the monsoon reached Chota Nagpur before it had become established further north, hence a large proportion of Hooghly water came from the Chota Nagpur districts. If the Ganges also, however, is in flood it dilutes these waters to such an extent that fine matter may become proportionately small in amount. Not only this, the Behar and Orissa waters in flood are softer waters than the Ganges flood water. It has been found that the harder the water in temporary hardness, the more quickly does suspended matter tend to fall and settle. The flood water of the Ganges therefore acts in a measure as a coagulant on the Behar and Orissa flood water. If, therefore, the upper Ganges is in flood we are less likely to have trouble with opalescence in Calcutta

The moral of this is that if we could get previous information of local floods in Chota Nagpur the Water Works Superintendent would be forewarned

and be ready to add additional alum as soon as the flood water from Chota Nagpur reached Pulta.

The Health Officer remarks as follows:—

I agree with Major Stewart as to the high velocities between tank and tank and have already pointed this out to the Committee. I think we must start chemical treatment before the break of the monsoon so as to have the tanks fully charged with alum ready to deal with the first red water coming down the river. Generally, I agree with the views.

Appendix "B."

Analyst's report on the bacteriological examination of samples of water taken from the points where the effluents of septic tanks are discharged.

In the month of July it was observed that in addition to the presence of slight opalescence in the physical appearance of the filtered water the bacteriological quality of the same had deteriorated to a certain extent in as much as lactose fermenters, which are usually found to be absent in 10 c.c., were found to be present. This lead to a certain amount of uneasiness in the public mind, and a question was raised in the General Committee if this was to be accounted for by inefficiency of the filter beds or by discharge into the Hooghly in the vicinity of Pulta intake of septic tank effluents of high bacterial content and insufficiently sterilized. As regards the filter beds it is to be observed that the sudden influx of a large volume of flood water during the latter part of June, carrying with it an unusual amount of suspended and colloidal matter put a severe strain on the filters, but judging from the reduction in the number of bacteria they were found to be working fairly satisfactorily. As regards the question of the quality of raw river water it was resolved by the General Committee on July 20 that a survey of the river might be made in this vicinity of our Pulta intake and I was selected for the work. The Director of Public Health, Bengal, was approached who very kindly not only put a motor launch immediately at our service for collection of samples but also deputed Rai Sahib V. Gobinda Raju, Assistant Bacteriologist, Public Health Laboratory, to help me in the work. I take this opportunity to acknowledge that had it not been for the ready and valuable help offered by Mr. Raju, who is thoroughly familiar with this part of the river, it would have been impossible for me to perform this work within so short a space of time.

Between July 25, 1922, and September 2, 1922, altogether 100 samples have been collected from the river from Shamnagore on the north to Khardah on the south. The procedure adopted was to collect the samples in sets of three, viz., the shore in the vicinity of the discharge pipe of the septic tang effluents, the middle of the stream and the opposite shore. A few samples were taken near the Pulta intake. A few samples of septic tank effluents were also collected.

The samples may be broadly divided into four groups.

I.—Midstream, where the water is generally good and may be taken as control.

II.—Shore or Bathing Ghat, within 400 feet from the place where septic tank effluents are discharged.

III.—Effluents from individual septic tanks.

IV.—Samples from the river close to open drains receiving effluents from groups of septic tanks.

In the bacteriological results the presence of *B. coli* and its number in 1 c.c. have been taken as the standard for expressing the existence of fæcal contamination and its amount. Sir A. Houston, Director of Water Examination, Metropolitan Water Board, says "The *B. coli* test stands to-day as the most practical and delicate and rapid test for excremental filth and may surely be taken as the most reliable indicator in its positive aspects of possible danger and in its negative aspect of its almost certain absence of micro-organisms associated with epidemic water-borne diseases and generally speaking as the one test which above all others it is least excusable for a water analyst to omit."

It is to be noted here that the samples have been collected in the month of August, when the river was very full, and the volume of water in the river very large. The number of samples taken is also not sufficiently large to form a definite conclusion, but the following tentative conclusions may be drawn from the facts already obtained—

(1) The midstream water is much purer than water on either shores, as many as 16 per cent. of the samples showing one fæcal bacillus in 1 c.c., whereas in the shore samples none of them reached this standard of purity

(2) The shore samples are decidedly inferior in quality to the midstream ones, indicating that the amount of fæcal pollution near the banks is appreciable in amount.

(3) The Pulta intake water is decidedly superior to the other shore waters at this time of the year, but it is not possible to state at present what the condition would be when the volume of water goes down considerably as in January or May.

(4) Of the septic tank effluents examined none of them showed less than 100 fæcal bacilli in 1 c.c. and as many as 58 per cent. of the samples showed at least 100,000 fæcal bacilli per c.c. and 8 per cent. 1,000,000 per c.c., which is practically of the same quality as crude human fæces.

(5) The effluents of the Titagur Paper Mills which were mixed with the waste hypochlorate liquor and in which the smell of chlorine was markedly present, showed the absence of fæcal bacilli even in 10 c.c. in one sample, and in 1 c.c. in three samples, and in only one sample ten fæcal bacilli were present per c.c.

This shows that it is quite possible to sterilize the effluents if only a sufficient quantity of bleaching powder is used for the purpose.

(6) The water of the Titagar Khal, which receives effluents from septic tanks and which flows into the Hooghly about two miles south of Pulta intake shows a high degree of fæcal contamination

14 per cent. of the samples showing 10,000 fæcal bacilli per c.c.

(7) The Kharda Khal water, which also receives effluents from several septic tanks and flows into the river a little further south of Titaghur shows a still higher degree of fæcal pollution, of 33 per cent. of the samples showing 100,000 *B. coli* per c.c. and 16 per cent. 1,000,000 per c.c.

(8) Ichapur Khal water, in contrast to Titaghur and Khardah Khal waters, is decidedly superior. I understand it does not receive any septic tank effluent of any jute mill.

But I must say here that the number of samples is rather small and taken during the height of the rains. To arrive at a proper conclusion it would be necessary to collect further data and also at other times of the year, say in January, at the height of the cold season, and in May, the driest part of the year.

I give below an extract from Rule 19 of the Bengal Factory Rules, published under Bengal Government Notification No. 953 T.G., dated June 24, 1912.

19 (viii) The effluent from a septic tank latrine installation shall not be discharged into any river unless—

(*a*) it is clear, free from fæcal odour and non-putrescible, and nitrification has definitely commenced, and

(*b*) it has been sterilized by the addition to each gallon of 5 grs. of fresh chlorinated lime.

Appendix "C."

The Analyst's report on special circumstances under which commercial ghee is manufactured in Gontour, Madras.

Part I.

In accordance with the resolution of the General Committee, dated June 30, 1921, recommending my deputation to Madras to study local conditions there and to investigate the special circumstances under which commercial ghee is manufactured there, I left Calcutta on October 2, 1921, and went to Gontour, from whence practically all consignments of Madras ghee come.

I stopped at Gontour and used to spend almost the whole day in visiting the following villages within a radius of eight miles from the town itself, viz., Kortepadu, Yetkuru, Gourantla, Nullapadu, Potur and Kakani. The principal contention of the dealers has been that in Madras ghee is manufactured from a mixture of milk of cows, buffaloes, sheep and goats, in which cows' milk predominates. I state briefly the conditions which I observed in the different villages.

(1) *Kortepadu.*—A village within two miles north of Gontour; here I came across a very large number of buffaloes and comparatively few cows. One, K. Keteswara Rao, a schoolmaster in the village, gave me the following figures—buffaloes 400, cows 40. He also made the following written statement:—

> "The people who keep goats are called *Gollas*. They keep them chiefly for getting manure and the milk is used for drinking purposes, and not generally used for making ghee."

Sheep and goats are not kept in this village.

I took some samples of buffaloes' and cows' milk and made ghee therefrom.

(2) *Yetkuru.*—A village about four miles south of Gontour. Here also I found the number of buffaloes to be very large and very few cows. One, Y. Sitaramayya, Kurnum, village accountant, made the following written statement:

> "I am a resident of Yetkuru, I know all villages within a radius of ten miles from here. I know that no ghee is manufactured from sheep or goats' milk. Ghee is manufactured from buffalo milk only; for instance, in this village there are about 400 buffaloes and only five or six cows—cows' milk is used for drinking only and if any ghee is manufactured from same it is sold separately at a higher rate, some villagers keep sheep and goats but they are used only for manuring fields, milk produced by them is small in quantity and is used generally for drinkng purposes. At Yetkuru there are no sheep or goats."

I purchased some samples of cows' and buffaloes' milk and also some butter.

(3) *Gourantla.*—About four miles to the north of Gontour. I counted the number of cows and buffaloes which I came across and found buffaloes 103 and cows 37. Of course, many cattle had gone to the jungle to graze, it being 10 o'clock. I found also some goats and sheep, about 15 in number.

One old villager told me that he had about 20 or 30 goats and sheep, but he could not supply any milk. He further told me that he receives money from the cultivators if he takes his flock to the fields for the excreta.

Another villager, Nagya, said that in the case of a cow in milk if there be a bull-calf they always let the calf have the whole milk, as bulls are more precious than cows and fetch Rs. 100 to 125 each.

As regards food, one Ketya said that the cattle graze in the jungles, they give only some rice dust.

Here I purchased some samples of cows' and buffaloes' milk for the purpose of making ghee.

(4) *Nullapadu.*—A village about four miles west of Gontour. Here also I found a very large number of buffaloes and very few cows. A very old man, Gobinda Reddi, told me that there were about 200 buffaloes and 50 cows there. In this village about 13 families keep sheep and goats, the total number of the latter being about 1,500. On inquiry, I understand that goats and sheep are kept by a separate class of people who are called *Dhangirs*, who are a low caste and are not allowed to mix with the general villagers. They don't keep cows or buffaloes. One of them explained to me that

they keep goats and sheep for the following purposes:—

(*a*) On receipt of money they allow these animals to graze in the fields and thus manure them.

(*b*) The milk produced is used by them and excess is made into butter and ghee.

(*c*) The young ones are sold to the butchers.

I could not get any milk from them though I tried. I purchased some cows' and buffaloes' milk for making ghee.

(5) *Potur.*—A village about six miles to the north-west of Gontour.

In this village about 200 families live, most of whom keep milch cattle. There are altogether about 200 buffaloes and 15 to 20 cows. Here a group of *Dhangirs*, about 35 in number, live, having about 1,500 sheep and goats.

I purchased some cows' and buffaloes' milk, and also some goats' milk for the purpose of making ghee.

(6) *Kakani.*—A village about six miles to the east of Gontour.

Here I counted the cows and buffaloes I came across (44 buffaloes and nine cows). As many cattle had gone out to graze I was told that the total number would be about 200. A group of *Dhangirs* live here. The total number of goats and sheep would be about 1,200.

A respectable resident of the village, Sella Nagaya, merchant, made the following written statement in Telugu, which I have had translated, "A sheep gives about six tolas of milk, very little butter is produced. Sheep are chiefly used for manuring purposes (dung)."

The samples of milk which I collected at various places were brought to my quarters and ghee made in accordance with the process adopted by the villagers. The samples were all brought down to Calcutta and analysed.

I saw the Chairman of the Gontour Municipality, the Deputy Director of Agriculture and the District Medical Officer.

PART II.

Breed of cattle—Cows.—I cannot do better than quote the following from "Cattle of Southern India," by Lieut.-Col. W. D. Gunn, *re* cows:—

"The cattle of the Madras Presidency have long been famous, and of the several breeds which are to be found in this part of the country, those designated the 'Mysore' and 'Ongolo,' sometimes also known as the 'Nellore,' are undoubtedly pre-eminent.

"The Nellore breed of cattle has a wide reputation throughout India, and even beyond its limits. Formerly the normal breeding localities were situated within the northern taluks of the Nellore District of the Madras Presidency but recently these taluks have been included in the new district of Gontour, so the cattle should not rightly be given the name of Nellore, but rather that of Ongole, from which tract the best specimens can be obtained."—(Page 26.)

Page 28.—"There is no greater truism than that which refers to the necessity of feeding young stock; and the very great care which the best breeders bestow on the young animals, both male and female, most certainly accounts for the well-deserved reputation of the Ongole cattle. The young calves are allowed to suckle the whole of the cows' milk, and when they are three months old are given grass and a small amount of mixed grains. In every way they are treated and tended as the family pets."

Page 29.—"A good Nellore cow gives from 11 to 12 pounds of milk daily. Young bulls sell from Rs. 80 to Rs. 250. A good Nellore cow is worth from Rs. 80 to Rs. 150, according to the amount of milk she yields."

Re Buffaloes.—I make the following extract from the same authority.

Page 50.—"In Southern India there are probably four distinct varieties, viz., the Toda, which are found on the plateau of the Nilgiri Hills, the Parlakamede on the Ganjam Hills on the east coast, the Malabar, the best of which are to be found in the south-western portion of that district and South Canara, and the *small nondescript variety* which may be seen everywhere."

Now, in Gontour and the surrounding villages, though in a few instances I have come across buffaloes of good breed, most of the animals there belong to the aforesaid *nondescript variety*, and the degeneration is evidently due to indiscriminate breeding. In size and in disposition they are just like the country cows found in Bengal.

The usual yield of milk of a buffalo is about four seers, the usual yield of a cow is about four to six seers. The price of a buffalo is about Rs. 40 to Rs. 60 whereas that of a cow is Rs. 80 to Rs. 90. The price of pure buffalo milk is As. 5 a seer, that of cows' milk As. 6 a seer.

Food.—The Deputy Director of Agriculture says: "Cattle are mostly fed in these parts on paddy Juar and Bajri straw in addition to grazing and green grass when available. Milch cattle get gingelly cake, cotton seed and rice bron in the neighbourhood of the towns, but in villages they are kept only on straw and grazing." My experience has also been the same. In the interior villages poor people cannot afford to give oil cake, but depend only on grazing in the jungles.

Manufacture of Ghee.—This is well described in the Year Book, 1919, of the Madras Agricultural Department (page 75):—

"Milk, preferably buffaloes', is boiled on an open fire, the chief fuel used being dry cow-dung cakes. These are preferred in virtue of their slow burning quality, a quality essental in milk boiling. A mud pot is the common utensil for such a purpose, which is covered with another mud pot when milk is boiled. During boiling the smoke freely permeates through the milk which gives the milk and curd the characteristic smell with which all are familiar. The milk is then allowed to cool for a while after it is first brought to the boil, when a small quantity of the previous day's curd is added to sour it. It is then laid aside till next morning."

Colonial Medical Reports.—No. 169.—Calcutta (*contd.*)

The whole curd is then churned with the Indian beater churn. When butter has formed and floats on the top it is gathered by hand, made into a ball, slightly washed on the outside and preserved along with the previous day's lot. When a sufficient quantity of butter has accumulated it is melted over an open fire; I have noticed that the temperature rises to 120° to 130° C.; curd present in the butter probably gives aroma to the ghee and at the same time leaves a sediment. When all the water is evaporated, and the characteristic sound of bubbling ceases, the ghee is then strained through a cloth and is ready for the market.

Collection.—The quantity manufactured by an individual villager is small and he lives miles away from the town. There is a separate class of men, the Hindus being called Kumti or Bakal, and the Mohammedans, Sahiblu, whose occupation is to visit the distant villages, collect the ghee, pack it in tins and bring it in large quantities to the exporting towns. Here it is sold in the public market and the wholesale dealers, after satisfying themselves by physical examination, purchase it and store it in the godowns of the commission agents or Aratdars, who advance them money on the security of these goods.

Special treatment of Ghee at the Arats.—At the godowns of the Aratdars or commission agents, there are big cauldrons of 40 to 50 maunds capacity where tins of ghee as they come from the mofussil are mixed, melted by the application of direct fire and re-tinned ready for export. I have noticed that the temperature of the ghee in the cauldron varies from 90° to 105° C. It is alleged, and it is to a certain extent true, that the ghee as it comes from the mofussil is not properly made as it contains a certain amount of moisture and casein, which changes the physical characters of the different consignments to a certain extent. Impurities like mud, dirt, &c., are also found to be present. The idea of mixing and melting the ghee in a big vessel is to get rid of these imperfections and to reduce the ghee to a uniform quality. But I am afraid this process at the same time gives great facilities for adulteration to those who are so inclined—I am credibly informed by local people there, both official and non-official, that many of the dealers, if not all, extensively practise adulteration at the time of melting the ghee in the cauldron, unhindered and unchecked. The local municipality has neither the legal powers nor the agency to check this wholesale adulteration. The District Medical and Sanitary Officer has got certain powers but he has various important duties to perform, being in charge of a big hospital there. The unscrupulous dealers thus went on with their nefarious practices without any hindrance till they got a rude check from Calcutta. The famous case of Corporation v. Grande Venkata Ratnam which cost the defendant nearly Rs. 40,000 (I was told by the defendant himself) made a tremendous sensation; and the decision of the case in favour of the Corporation and the vindication of the Corporation figures in the face of the opinions of European experts not only saved the situation but also struck terror into the hearts of the unscrupulous —Madras ghee fell into disrepute, the price went down, and it attracted few customers. But I am glad to say that many of them have since changed their tactics, I have noticed that some of them at least try their best with the resources at their command to secure the best ghee possible. The effect of this is very noticeable in the Calcutta market, where in 1921 the proportion of adulterated samples in Madras ghee is very small in comparison with previous years. But though most of the consignments from Gontour come to Calcutta, some at least go to other places and a really effective check can only be effected at the place of production.

CONCLUSIONS.

1. The principal contention of the dealers in Madras ghee that commercial ghee there is manufactured from a mixture of milk of cow, buffalo, sheep and goats is baseless. The chief source of ghee supply is the milk of buffaloes. Cows' milk and cows' ghee are dearer. Sheep and goats are kept by a separate class of people (*Dhangirs*) for manuring fields and for meat. The Deputy Director of Agriculture confirms my experience.

2. Buffaloes in Gontour do not generally belong to any of the well-known varieties found in Southern India, though a few are to be found. Those usually kept by villagers belong to the "nondescript variety"—a product of indiscriminate breeding. In size, habits and temper they resemble the country cows of Bengal, the yield of milk is also similar, viz., two to four seers, and the price of an animal is less than that of a cow. The cows belong to the beautiful "Ongole" breed and are very much prized—the bulls are highly valued and are used for draught purposes and for ploughing fields. They sell at a higher price than buffaloes.

3. From the small number of analyses performed it is not possible to form an opnion as to any special features possessed by Gontour ghee. It is indeed true that some individual samples have given results that are lower than any we have hitherto received, and it is quite possible that the poor condition of the cattle, which in most cases pick up what they can grazing in the jungle, and the practical absence of any fodder in the fields at this time of the year (the rainy season begins here in the middle of October) may account for these results. But at the same time it is to be noted that the yield of milk from individual milch cattle in the district is very small, whilst commercial ghee is a mixture of the products of a very large number of animals, which varies within very narrow limits from the average, and tends to eliminate abnormal results. It will also be apparent from the results of analysis that samples taken from mixtures of several tins almost always give figures of 28·0 c.c., and above. Even if it be conceded that ghee from villages far from the towns is inferior in quality compared with ghee from other parts of India, where more care

is given to the food of the cattle, that is no reason why we in Calcutta should allow such inferior stuff to be sold in our markets. In my opinion we should insist on their complying with our standard of 28·0 c.c. As a matter of fact practically all good commercial samples of Gontour ghee will pass this standard.

I may further observe that if the standard be lowered to meet some of the abnormal samples of Gontour ghee it will neither be fair to dealers in ghee from other parts of India nor to the public of Calcutta, as it will allow a considerable quantity of adulterated ghee to escape detection.

T. K. GHOSE.

Health Officer's opinion:—

"I have read the very interesting report submitted by the Analyst and have discussed it with him. I agree generally with the conclusions he has arrived at. I certainly see no reasons for modifying our standards of purity."

H. M. CRAKE.

Colonial Medical Reports.—No. 170.—Trinidad and Tobago.

ADMINISTRATION REPORT OF THE SURGEON-GENERAL FOR THE YEAR 1923.

I HAVE the honour to submit for the information of His Excellency the Governor and the Legislative Council the following report of the medical department for the year ended December 31, 1923.

FINANCIAL.

Provision was made as per revised estimates for 1923, for the requirements of the medical department under head twenty-two, medical, for the sum of £31,943 16s. 3d., of which £30,291 16s. 3d. was actually expended, and a saving of £1,652 effected.

The amount provided under head 23, "Hospitals, Asylums and Dispensaries" was £100,890 18s. 11d which includes a supplemental vote of £896 for the purchase of a new launch for the use at the Chacachacare Leper Settlement, on which there was an actual saving of £4,881 14s. 1d., the actual expenditure being £96,009 4s. 10d.

Under heading "Public Health" including quarantine, provision was made for £17,124 17s. 9d., of which £16,290 1s. 10d. was actually spent, and a saving effected of £834 15s. 11d.

The total savings on the various votes controlled by this department was £7,369 10s. 0d., of which £530 15s. 1d. was contributed by the ankylostomiasis campaign vote.

The average annual cost per bed at the twelve Government Medical Institutions was £49 16s. 2d., as compared with £52 11s. 1½d. in 1922 and £55 4s. 8½d. in 1921, while the cost per bed per diem was 2s. 8d., as compared with 2s. 10½d., in 1922 and 3s. in 1921.

The revenue credited to the various medical institutions during the year was £4,682 19s. 6½d., as compared with £4,030 18s. 9½d. in 1922.

MEDICAL ATTENDANCE ON THE POOR.

The number of applications in Port-of-Spain during 1923 was 22,557, as compared with 25,942 in 1922, while the figure for the whole Colony was 58,530, as compared with 57,636 in 1922.

VENEREAL CLINICS.

The clinics established in Port-of-Spain and San Fernando continue to be highly appreciated by the general public.

RECOMMENDATIONS.

(*a*) The provision of a residential nursing home at the Colonial Hospital, Port-of-Spain.

(*b*) The completion of the nursing home at the Colonial Hospital, San Fernando.

(*c*) The appointment of a whole time medical officer for Chacachacare Settlement.

(*d*) The provision of a motor ambulance for Tobago.

K. S. WISE.
Surgeon-General.

HOUSE OF REFUGE, 1923.

I have the honour to submit for your information the annual report for the House of Refuge for 1923.

The general accommodation of the institution is satisfactory.

The staff numbers thirty-seven.

There is no housing accommodation for the staff save the resident superintendent, who is provided with quarters, and the steward who gets rent allowance and resides away from the institution.

During the year the following changes amongst the staff took place: Nurse Stewart resigned in March, 1923, and was replaced by Nurse Parris; Wardsman J. C. Jackman was dismissed, he having been charged by the police with wounding and sentenced to imprisonment and was succeeded by V. Marshall.

The buildings are in a dilapidated condition and require immediate repairs.

The grounds are in a fairly good condition, but some of the roads require a little gravelling.

The water supply is good and sufficient. Some

of the drains require repairs. The pail system is still in use and the latrines require some repairs to make them fly-proof.

The dietary is good and sufficient.

The accommodation for the patients is satisfactory and they all seem contented.

R. McLEAN.
Medical Superintendent.

COLONIAL HOSPITAL, 1923.

I have the honour to submit the following report of the Colonial Hospital, Port-of-Spain, for the year ending December 31, 1923.

Administration.

The extern maternity department has been doing good work during the year and has proved a most useful as well as efficient adjunct to the Victoria Maternity Ward in Hospital, whither the difficult cases are transferred by the district midwives.

Number of cases treated outside by district nurses ...	287
Number transferred to hospital requiring special obstetric skill	85
Number of visits paid by district nurses to midwifery patients at their homes	2,810

Anti-typhoid inoculations were started at the surgery of the Colonial Hospital on October 19, 1923, and 948 people have availed themselves of this facility.

The Princess Mary Medals for nursing were awarded for the first time this year and have proved to be a valuable incentive to keen and efficient competition among the nurses of the Colonial hospitals, Port-of-Spain, and San Fernando.

The sucessful candidates, Nurses Anderson (gold medallist) and Sealey (silver medallist), were presented with their medals at a special ceremony held at the Town Hall, Port-of-Spain, on November 8, 1923, which was largely attended, and I take this opportunity of expressing thanks in the name of the nursing staff of this institution to the mayor and councillors of the city of Port-of-Spain for the kind thoughtfulness and the noble ideals which have prompted the award of these medals. It is now left to the nurses of the Colony to live up to these ideals, and I have no doubt that they will do so.

The usual bi-yearly examinations for nurses in training were held in July and December. There were thirty-seven entrants from this institution, of whom thirty-one passed and six failed.

Buildings and Grounds.

Minor repairs to the various wards have been carried out. With a view to economy, no extensive alterations have been made except the screening of the northern and eastern side of the Tuberculosis Ward, which was too exposed to the weather.

Some necessary improvements in the kitchen and laundry have been unavoidably postponed.

No. 11 Ward, which is used for chronic male cases, is dilapidated beyond repair. Instead of building a new ward at the hospital for these cases, I consider it would be preferable to make provision for their accommodation at the House of Refuge.

The grounds are in fairly good condition.

Water Supply and Sanitary Arrangements.

The water supply has been ample and of good quality.

The sanitary arrangements are up-to-date and kept in good repair.

Dietary.

The diet scale continues on the whole to give satisfaction. A few minor additions and improvements are now being introduced, the most important of these being the substitution of fresh milk for condensed milk for practically all hospital cases.

Accommodation.

The authorized number of beds in the institution is 340. The chronic wards are usually overcrowded, due to cases which belong to the House of Refuge class having to be kept in hospital owing to lack of accommodation elsewhere.

Greatest number of patients in hospital on any one day	388
Lowest ,, ,, ,, ,,	284
Average ,, ,, ,, daily ...	336

During 1923 the number of in-patients treated at hospital was 5,849. Of these 4,697 were discharged and 834 died.

The high mortality is mainly due to the frequency with which patients were admitted in a very advanced stage of their disease and to the many advanced cases of pulmonary tuberculosis and senile cases that are permanently accommodated at this institution.

The number of casualties treated in the surgery, exclusive of in-patients, was 2,780.

Diseases.

The chief diseases treated were as follows:

Diseases	Number of cases	Number of deaths
Venereal diseases	328 ...	33
Pulmonary tuberculosis	307 ...	170
Enteric fever...	240 ..	45
Malaria	199 ...	18
Chronic nephritis	185 ..	75
Bronchitis (acute and chronic) ...	174 ...	26
Ulcers	166 ...	—
Dysentery and diarrhœa	129 ...	22
Lobar pneumonia	128 ...	57
Ankylostomiasis	113 ...	14

Surgical Operations.

A separate return of surgical operations is attached. There were 1,652 major operations performed during the year.

R. C. WUPPERMAN,
Resident Surgeon.

SAN FERNANDO HOSPITAL, 1923.

I have the honour to submit the following report on the Colonial Hospital, San Fernando, for the year ended December 31, 1923.

The midwifery examination was held at Port-of-Spain in August. There were four candidates from San Fernando Hospital, two passed.

The nurses' examination was held at Port-of-Spain in December. There were twenty candidates from San Fernando Hospital, eight third year, six second year and six first year; of these five third year, four second year, and six first year candidates passed.

Throughout the year the medical staff consisted of only two medical officers. It is impossible to emphasize too much the need for a third medical officer. The work would be very much facilitated by the appointment of a permanent senior assistant.

Quarters were provided for the resident surgeon, assistant resident surgeon, matron and dispenser.

Buildings.

The female wards and maternity ward are in good condition. The male wards are in bad condition and in need of repairs and painting. The central block, containing the surgery, offices, dispensary, and matron's and dispenser's quarters, is also in need of repairs and painting. Work in the kitchen was performed under difficulties throughout the year, on account of the bad condition of the kitchen range.

The Public Works Department handed over the first wing of the Nurses' Home in March. In April a retaining wall was built to the west of the hospital grounds to secure the Tuberculosis Ward: the old laundry was demolished and a new one built on a site south of the former one. Both operating theatres were painted in December.

The resident surgeon's house is in very bad condition. Extensive repairs are necessary and also a new fence.

The condition of the assistant resident surgeon's house is unsatisfactory, owing to the shifting nature of the land on which it is built.

Grounds.

The hospital grounds are not enclosed, a proper fence completely enclosing the grounds is required. The roads in the grounds are in need of constant attention, this would be overcome by having them properly conditioned and oiled. The paths connecting the different buildings are neither paved nor oiled, and so with the amount of traffic that must go on in and out of the wards, it is impossible to keep the floors as clean as they should be, especially in the rainy season.

A small flower garden was maintained and the kitchen garden yielded some return.

The retaining wall recently built to secure the Tuberculosis Ward is bulging and cracked; this requires immediate attention.

Water.

The water supply was ample and good.

Sanitary Arrangements.

These are unsatisfactory. The installation of a modern sewerage system is urgently required. The drainage can be improved.

Dietary.

The diet is satisfactory and the cooking good. The meals, however, are served very irregularly owing to the bad condition of the kitchen range and the consequent difficulty in getting the food cooked in time.

Accommodation.

Accommodation is provided for 153 patients. Twenty beds are reserved for cases of tuberculosis and seven for difficult midwifery cases. There are three rooms for private patients.

Seventy patients were admitted to the Maternity Ward for treatment. The extern midwives attended to 81 cases; they made 731 visits.

There were 347 deaths in the hospital.

Venereal Clinic.

This was opened daily for the treatment of patients. 100 cases of gonorrhœa and 233 cases of syphilis were treated. 801 injections of neo-salvarsan were given and forty-nine injections of mercury, *i.e.*, each syphilitic patient got an average of 3·5 injections of neo-salvarsan and 0·2 injections of mercury. This is very unsatisfactory as under such conditions a very low percentage of possible cures can be obtained. The assistant resident surgeon attends at the clinic on Wednesdays and Saturdays.

The chief diseases treated were:

Disease	Number of cases	Number of deaths
Ankylostomiasis	172	29
Venereal	153	3
Malaria	152	12
Bronchitis	102	7
Pneumonia	101	29
Phthisis	71	36

J. E. A. BOUCAUD,
Resident Surgeon.

LUNATIC ASYLUM, 1923.

I have the honour to submit the annual report on the working of this institution during the year ended December 31, 1923.

ADMISSIONS, RECOVERIES, DEATHS.

The admissons, which exceeded those of the previous year by thirty-three, the increase being equally distributed among males and females, were still below the average of the preceding quinquennial period: "Mental anxiety" and "Adverse circumstances" were assigned more frequently than usual as the exciting causes of the mental attack. Hereditary predisposition was obvious or ascertainable in fifty per cent. of the admissions.

Only nine of the admissions improved sufficiently to be discharged within the year, the average stay in asylum of those discharged on recovery being over three years. The benefit of prolonged detention under institutional treatment is, however, well reflected in the low percentage (eight per cent.) of re-admissions to this asylum.

Colonial Medical Reports.—No. 170.—Trinidad and Tobago (*contd.*)

The number of deaths (eighty-six) slightly exceeded that of 1922, but was also below the average of the preceding quinquennial period. Thirteen of the deaths were of inmates between sixty and eighty years of age. Tuberculosis caused eighteen deaths.

The ratio of certified insane to population in the Colony is now just under 20 per 10,000. (In Great Britain the ratio is about 30 per 10,000.)

Accommodation.

There were at the end of the year under review forty-one vacancies for males and seventeen for females—a welcome postponement of overcrowding. The total number under treatment was 795

Buildings, Water Supply.

The buildings are in good order. The water supply proved ample. " Foamite " hand fire extinguishers were installed in those officers' quarters which were beyond the reach of the fire hydrants.

Employment.

The extension of ground cultivation and of artisan work afforded throughout the year valuable employment and training for a large number of the inmates. The daily average number employed throughout the institution exceeded forty per cent. of the total number resident, while the value of the produce and of the labour of the inmates was over £3,000.

Health of the Institution.

Typhoid fever made its appearance among the inmates in August. Four females (one death) and three males were attacked. No definite focus of infection in the asylum could be traced. The disease was probably introduced in contaminated fruit and sweets brought in by visitors. The incidence of asylum dysentery was considerably less than in recent years.

GEO. A. VINCENT,
Medical Superintendent.

LEPER ASYLUM, 1923.

I have the honour to submit the following report for the year ending December 31, 1923.

The general accommodation of the institution is sufficient for staff and patients and the general health of the latter is well maintained.

The staff consists of two superintendents (one at Cocorite and the other at Chacachacare), a dispenser and a steward at Cocorite and a dispenser-steward at Chacachacare; all of whom are resident.

Added to the staff are twenty-three employees at Cocorite and eleven at Chacachacare. Cocorite has also seventeen sisters as resident nurses. The eleven employees at Chacachacare live on the Settlement.

The scale of diet approved by His Excellency the Governor on March 27, 1923, is satisfactory.

Cocorite.

During the year the services of three nurses, three warders, two watchmen, a cook, a baker and a laundress were dispensed with at Cocorite.

The wards require painting. The roofs of the wards covered with genasco, the galleries of Wards 2 and 4, and the room of the closet-attendant are in need of repair. On the whole, however, the buildings are in fairly good condition.

The water supply is ample and of good quality. The drainage and sanitary arrangements are good. The incinerator works well.

The gully which runs through the grounds of the asylum has to be cleared of debris periodically during the rainy season to prevent the flooding of the quarters of the resident superintendent and the nursing staff.

Christmas toys are distributed by Miss Pierre who with her co-workers and friends of the institution deserves our warmest thanks for the pleasure which their arduous work and generosity afforded.

The sisters carried on their work of mercy with the efficiency and patience that has continuously marked their efforts for the last fifty-five years, during which their religious house has been in charge of the Cocorite Asylum.

There are twelve wards which provide ample accommodation for the 300 patients now there.

Early in November there was an outbreak of diarrhœa. More than a third of the inmates (117) were attacked. With the valuable assistance of the sisters the disease was kept under control and there was only one death.

Nineteen Indians were repatriated in 1923.

Chacachacare Settlement.

The transfer of inmates to Chacachacare continued and sixty-nine patients were sent from Cocorite to the Settlement during the year. 157 lepers are now satisfactorily accommodated there (December 31, 1923).

Of the twenty-six cottages on the Settlement, ten were built in 1923. A good oven has been built and the supply of bread has been fully equal to the demand.

The supply of water has given rise to some anxiety but used with care has been sufficient for the needs of the patients.

The laundry work of the Settlement is done at Cocorite.

E. HAMEL SMITH,
Medical Superintendent

Colonial Medical Reports.—No. 171.—Mauritius.

ANNUAL REPORT ON THE MEDICAL AND HEALTH DEPARTMENT OF MAURITIUS FOR 1923.

Vital Statistics.

The area of the Mauritius is 720 square miles (460,800 acres) and the estimated population on December 31, 1923, was 381,678.

The density of population is very high, being about 530 per square mile for the whole island.

Births.—The total number of births for the year was 13,879.

Deaths.—During the year 1923 the total number of deaths was 10,778.

The mortality in 1923 was very low for Mauritius. The death rate for the whole colony is the *lowest since* 1891.

The number of deaths due to malaria and cachexia (highest death-producing factors in Mauritius) is 1,979.

No doubt can be attached to the improvement in the health conditions if it is remembered that in Port Louis no death is registered unless certified by a medical practitioner.

The number of deaths due to malaria in Port Louis in 1923 is 169.

It can therefore boldly be advanced that Mauritius is already remarkably deriving the benefit that was justly expected from the improved and energetic methods of public health campaign started three years ago and pushed on unremittingly.

The next high causes of death are: pneumonia and broncho-pneumonia (1,393 in 1923) and diseases of early infancy (1,026 in 1923).

Deaths due to preventable diseases, i.e., diseases due to faulty sanitary conditions, overcrowding, soil infection, defective or infective water supplies numbered 4,227.

This figure does not include infantile diarrhœa or infantile convulsions, both probably due to improper dieting and neglect.

Infantile Mortality.

It is a valuable index from the public health point of view and may be described as the index of community intelligence, for generally speaking it is found that the better educated and better housed sections of the community usually show lowest rates.

The rate for 1923 was 139·4 per cent.; the number of deaths under five years, 3,587.

Having regard to the total number of deaths for the year, viz., 10,778, the proportion of deaths under five to total deaths is so high as 33·3 per cent.

As usual, the most important cause of infantile mortality is congenital debility.

The number of still-births registered during 1923 is 1,557.

It is equivalent to 112·2 of live births for the same period.

The principal causative factors of infantile mortality continue to be: venereal diseases, congenital debility, premature birth, improper food and methods of feeding.

Many children on birth are mere weaklings and are doomed to early death owing to the early marriages amongst Indians and child-bearing at immature age, work of expectant mothers in the fields, hardships and privations in the poorer classes, apart from the main causes mentioned above.

These causes are *per se* sufficient to lead to death during the later months of gestation.

Infantile mortality is in every country usually higher among males than among females, except in the case of whooping-cough.

During 1923 the deaths under five years were 3,587.

Midwifery and Child Welfare.

During 1923 the questions of proper training of midwives and of placing gratuitously the services of Government paid midwives at the disposal of the poor in populous centres were thoroughly reconsidered.

Government proposes to provide Rs. 5,000 subsidy the next financial year to the dormant Midwifery and Child Welfare Society.

Prevalence of Sickness and Recurrence of Particular Diseases.

The number of cases treated in the public hospitals and at the dispensaries for 1923 is 82,326. These figures show a decrease as regards hospital admissions and dispensary cases

Malaria.

Malaria is not a notifiable disease in Mauritius so the number cannot be accurately given beyond admission for the disease in hospital, treatment at dispensaries and deaths certified by medical practitioners.

The total number of admissions in hospitals for malaria (hypertrophy of spleen included) was 1,774. The case mortality was 2·1 per cent.

The death-rate for malaria per thousand of population was 5·1.

The rates for deaths returned under malaria and malarial cachexia were 5·2 for 1923.

The admissions during the year under review were for malaria 1,558, deaths 35; admissions for hypertrophy of spleen 216, deaths 3.

In the public dispensaries a total of 19,268 cases of malaria were treated.

Spleen Examinations and Blood Tests for Malarial Parasites.

Spleen census of school children continues to be taken twice during the year.

The conclusion to be drawn from the examinations made in 1923 is a general decrease in the prevalence of malaria.

The total number of children examined is 12,925.

The examination of the blood of school children with a view to ascertaining the presence of malarial parasites has been carried on by a trained microscopist all the year round.

PNEUMONIA.—In the whole colony the total number of deaths is 1,083.

The admissions into hospitals were 287 with 103 deaths.

INFLUENZA.—In the whole colony the deaths stand at 556. The hospital returns show 1,192 admissions with 53 deaths. The hospital case mortality in 1923 was 4·4 per cent.

BRONCHITIS.—The total deaths registered in the colony numbered 521.

In this case the hospital admissions reached 925 with 23 deaths.

DYSENTERY.—Dysentery is not a notifiable disease in Mauritius. The mortality due to that disease in 1923 was 318. The hospital admissions show 379 with 24 deaths. The hospital case mortality was 6·3 per cent.

In the dispensaries 1,573 cases were treated.

ENTERIC FEVER.—In the whole island 150 cases were registered.

The months of particular prevalence were April and August.

Seventy-seven cases were treated in hospital.

The deaths (thirteen) gave a case mortality of seventeen per cent.

LEPROSY.—The number of inmates at St. Lazare Leper Asylum on January 1, 1923, was thirty-seven.

There were sixteen admissions during the year, two deaths and fourteen discharges. There remained thirty-seven lepers at the end of the year.

Leprosy is not a notifiable disease in Mauritius. It is probably common enough in the colony. Every day cases are met with in the streets of Port Louis and elsewhere. No restriction is made except as regards mendicant and criminal lepers.

No law exists for the compulsory segregation of lepers. Thy wander about at liberty, living with their families and transmitting the disease. There is no power to prohibit marriages between or with lepers, hence the hereditary taint continues to be spread.

The construction of the new (Powder Mills) Leper Asylum has been completed and the opening of the institution effected on January 1, 1924, by the transfer of the lepers.

In the draught Public Health Ordinance leprosy is made notifiable and the segregation of pauper, convict and vagrant lepers is rendered compulsory.

Treatment is given in the form of injections of moogrol. "Oscol" stibium has also been received in connection with leprosy treatment and with the opening of a new leper asylum under the management of another medical officer, the systematic treatments with moogrol and "oscol" stibium will be started in the near future.

PLAGUE.—The cost of the rat campaign works out for 1923 at fifty-one cents per rat caught.

In 1923 human plague prevailed practically all the year round in Port Louis.

Rat catching was persevered with throughout the year, and every rat caught, killed or found dead was examined bacteriologically.

During the year all grain stores were regularly and often fumigated by means of the Clayton apparatus.

METHOD OF TREATING CONTACTS.—(*a*) Disinfection—All premises, both of patients and of contacts were claytonized; (*b*) burning of rags; (*c*) isolation of patients as well as contacts *in situ* or in lazaret; (*d*) bathing of contacts; (*e*) inoculation by prophylactic vaccine.

DIPHTHERIA.—In the whole colony forty-seven cases were notified and five deaths registered. Five cases were treated in hospital with one death.

MEASLES.—This disease was made a quarantinable disease.

Nine cases were notified in December, 1923. No hospital admission.

CANCER OR MALIGNANT DISEASE.—Eighty-seven cases admitted into hospital with nine deaths.

DIARRHŒA AND ENTERITIS.—In the whole colony 625 deaths occurred. In the hospitals 506 cases were admitted resulting in forty-five deaths, giving a case mortality of 8·9 per cent.

ORGANIC DISEASES OF THE HEART.—Deaths from organic diseases of the heart numbered 151 in 1923. The number of cases admitted to hospital was 117 with twenty-two deaths.

VENEREAL DISEASES.—Twenty-two deaths were registered under syphilis in 1923. In hospitals 254 cases were treated. Five deaths resulted from these.

It is proposed to open the Venereal Clinic in the near future. As already stated, venereal disease is probably of more frequent occurrence than the above figures would otherwise denote. Most cases are concealed, a few treated by private medical practitioners, and only cases which incapacitate from work seek admission into hospitals.

NOTIFIABLE CONTAGIOUS AND INFECTIOUS DISEASES.—Ordinance No. 47 of 1898 provides for the compulsory notification of plague, cholera, choleraic diarrhœa, small-pox, yellow fever, diphtheria and membranous croup, measles, scarlatina or scarlet fever, and the fevers known by any of the following names: typhoid or enteric, typhus, relapsing or continued and puerperal; and traumatic erysipelas and of any other disease that may be added thereto by regulations. Cerebro-spinal meningitis has been made notifiable; so also the disease known as Spanish influenza.

CEREBRO-SPINAL MENINGITIS.—One case was notified; it ended fatally. Two other patients were

treated for the same disease during the year under review.

ERYSIPELAS.—Sixteen cases were notified and nine deaths registered.

Hospital admissions numbered twenty-four, resulting in four deaths.

SMALL-POX AND VACCINATION.—There has been no small-pox in the island since 1913. A total of 9,179 children were vaccinated during the year and 9,093 were successful vaccinations. In eleven cases the results could not be ascertained. In some cases vaccinations are privately performed, these are not included in the above figures.

PUERPERAL SEPTICÆMIA.—In the whole colony 228 women died in consequence of the puerperal state. Twenty-four cases of puerperal septicæmia were treated in hospitals, resulting in nine deaths —eighteen notifications were received during the year.

13,879 births having been registered during the year, the mortality among women in child-birth is 16·4 per thousand of live births, a very high figure.

ITCH (SCABIES).—154 cases were treated in the hospitals.

ANKYLOSTOMIASIS.—Fifty-one deaths were registered during the year. 500 cases were treated in the hospitals, with thirteen deaths.

BERI-BERI.—(Not notifiable).—Five deaths were registered in the whole colony.

Thirty-one cases were treated in the hospitals, resulting in two deaths.

PULMONARY TUBERCULOSIS.—Notification of pulmonary tuberculosis is not compulsory in Mauritius. In the new Health Ordinance the disease is made notifiable.

Hospital admission indicate a further decrease in the prevalence of the disease, 368 in 1923.

The mortality from pulmonary tuberculosis in the whole colony was 828.

CHICKEN-POX.—Five cases were treated in Beau Bassin Prison Hospital.

MENTAL DISEASES.—The total number of persons certified insane on December 1, 1923, was 708.

The causes of insanity are reported to be mental worry, grief, hysteria, fever, influenza, heredity, alcoholism, epilepsy, syphilis and gandia smoking.

Summarizing the experience of 1923, insanity caused by alcoholism, toxic mania, opium and gandia smoking appears to decrease whereas puerperality and hysteria have been factors bringing in the asylum more patients than usual.

Treatment with arseno benzol, bismuth, enesol has proved beneficial, so also has been the introduction of scopolamin and morphine in the treatment of excitement.

SOIL SANITATION.—The soil sanitation campaign has been pushed on very energetically during 1923. New regulations have been put into force regarding septic tanks, disposal of human excreta and trenching and manure factories, regarding the removal of house refuse, &c. New regulations have also been put into force relative to the provision of pail and pit latrines of approved type.

It is expected that soon every district will have been sanitated, i.e., every premises provided with an approved type of disposal of dejecta, viz.: septic tank, pail latrine or pit latrine.

ANTI-*MALARIAL* WORKS.—The work has consisted mainly in the maintenance of existing works, repairing of damage done by animals and floods, clearing of marshy lands, filling up of quarry pits and weedy pools and ponds, planting grass in former river or stream beds and petrolization of large marshes. The staff of trained moustiquiers did good work in the search of mosquito-breeding places all over the island.

THE CIVIL MEDICAL STORES.

The following tabular statement summarizes the transactions of the medical stores during the year 1923:

1.—Cost of drugs, chemicals, instruments and repairs to instruments and appliances, &c.	Rs.	103,601.80
2.—Value of drugs, chemicals, instruments, &c., issued to Government Institutions ...	Rs.	75,701.33
3.—Value of disinfectants, sera, vaccine &c., issued in connection with plague and other contagious diseases	Rs.	41,536.89
4.—Amount realized by sale of medicines, vaccine and sera to private medical practitioners and value recovered for loss and damage to instruments issued to Institutions	Rs.	1,755.70
5.—Quantity of Quinine issued		12,087 *oz.* 272 *grs.*
6.—Cost of Quinine issued ...	Rs.	22,735.14

7.—Institutions to which drugs in general are issued:

Hospitals	12	Schools	150
Dispensaries ...	31	Police Stations ...	54
Charitable Institutions	10	Govt. Institutions	15

The total number of notifications of infectious diseases (exclusive of plague) received during the year was 258.

The number of plague cases in the colony during the year 1923 was 139; the number of deaths 118.

DESTRUCTION OF RODENTS.

The number of rodents caught in Port Louis and country districts was 83,361.

29,223 were microscopically examined and the number found plague infected during the year was 568.

ABRIDGED REPORT ON THE WORK DONE FOR THE RELIEF AND CONTROL OF HOOKWORM DISEASE BY THE DEPARTMENT OF ANKYLOSTOMIASIS DURING THE YEAR 1923.

1. *Organization.*—During the year a great deal of time has been spent in propaganda.

On September 15, a branch office was opened in Moka, systematic work in the district was started and the year ended with the prospect of Moka being very soon completely sanitated.

Colonial Medical Reports.—No. 171.—Mauritius *(contd.)*

The schools were systematically examined and treated, and treatments were given in the branch dispensary, and the inhabitants were assembled at numerous centres for treatment.

2. *Extent of Operations.*—Although Moka is the only district where regular systematic intensive work has been attempted, the influence of the campaign has extended all over the island. Specimens have been received from all parts of the island, and there have been many requests for treatment or advice. These applications were from private individuals and also from public and private institutions. The local medical practitioners have very frequently referred their patients to the laboratory and a large number of treatments have been taken privately for hookworm and other intestinal parasites, which have not been within the scope of the control of the department and therefore not included in the statistics. A number of estates have also treated their own labour force, and numerous treatments have been given in Government dispensaries and hospitals throughout the island.

3. *Examinations, Treatments and Cures.*—The figures for examinations, treatments and cures during the year are as follows: Census 15,198, examined 12,540, infected 7,846, treated 5,506, cured 1,010. Both oil of chenopodium and carbon tetrachloride were used for treatment, the patients being administered either drug or a mixture of both.

4. *Infection with other Parasites.*—The number examined for hookworm disease was 12,540, of those incidentally found positive for ascaris 6,908, trichocephalus 8,294, strongyloides 11, oxyuris 22.

5. *Educational.*—Fifty-five lectures were delivered and literature distributed.

The cinema film "Unhooking the Hookworm" was ordered and delivery expected during the month of January.

6. *Per capita cost.*—The actual expenditure for the campaign during the year amounted to Rs. 29,702.16. Of this sum the International Health Board contributed Rs. 19,959.69, the Government's expenses being Rs. 8,742.47.

7. *Sanitation.*—The Medical and Health Department has expended a great deal of energy in trying to control and improve the sanitation, and regulations have been adopted dealing with trenching and the disposal of engrais. Unfortunately, it took a considerable length of time to accomplish results on account of existing contracts and local conditions.

1,698 pail latrines were completed by December 31, in Moka district, and the pail contents disposed of by deep trenching. In some sections pail latrines were built and in other places the pit was built where it would not pollute sub-soil water.

ANNUAL REPORT ON PORT LOUIS FOR THE YEAR 1923.

Vital Statistics.—The following figures for the town and district of Port Louis are taken from the report of the Honourable the Registrar-General: Population, 51,769; birth-rate, 39·9 per thousand; death-rate, 34·1 per thousand.

Reorganization of the Sanitary Staff.—A certain amount of reorganization and consolidation of the sanitary personnel was undertaken during the early part of the year.

The most important change was the extension of the responsibilities of the sanitary inspectors. The post of controlling officer was abolished, the plague services and anti-malaria gangs were reorganized so as to place them directly under the control of the sanitary inspectors who were thus given a more responsible, but at the same time a more stimulating share in the duties of the department.

Towards the end of the year the remainder of the anti-malaria work in the Port Louis district passed into the charge of the M.O.H. who thus assumed the responsibilty of all the sanitation of the district.

An important result of the reorganization referred to above was that provision could be made to reinforce the weaker branches by the creation of new posts out of the savings effected by the change. This was duly accomplished. The sanitary inspectors and guards welcomed the new arrangements and did their best to do their part in making it a success.

Class of Instruction.—While the reorganization was being worked out, the department's responsibility to the sanitary staff was fully recognized, and it was decided to hold classes of instruction which would help the personnel to a fuller appreciation of their duties. On April 12, the director inaugurated the class by delivering to the members a short and stirring address. The class, which is held every Thursday afternoon, is attended by all the sanitary personnel of the Northern districts.

The M.O.H., Port Louis, has delivered lectures on elementary physiology and hygiene, the epidemiology of the commoner communicable diseases, disposal of night-soil, and water supply; while sanitary inspector Purvis has given eight lectures on the elementary mathematics of hygiene. The programme of lectures has been based on the syllabus of subjects issued by the Royal Sanitary Institute and it is hoped that ultimately a certain number of candidates will be prepared to present themselves for the examination for the certificate of competency granted by the institute.

Communicable Diseases.

Three communicable diseases are of major importance in Port Louis: they are malaria, plague and enterica.

Anti-Malaria Work.—225,293 feet of existing drains and canalised streams were upkept. In addition, a small marsh at Grand River North West Village was drained into the river mouth. This marsh harboured the larvæ of *A. mauritianus* as well as those of *A. costalis*.

The clearance of a zone half a mile in depth in the Pitot and Tranquebar Valleys has continued

throughout the year. Until the end of September the work was carried out by the malaria authority. The object of the zone, which was recommended by Dr. Balfour, is to prevent the invasion of the city by mosquitoes coming from the jungle areas in the upper parts of the valleys. By the end of the year an area of 195 acres had been cleared of cactus and other rank vegetation in the locality. Unfortunately, it was not found to be possible to undertake work in the valleys themselves, only the Crown Lands on the adjacent hills having been dealt with. The work is carried out in three operations, cutting and stacking the cactus, allowing a period for desiccation and finally burning it as often as is necessary.

In the intra-urban area the anti-mosquito campaign has been steadily pursued throughout the year. Culex and stegomyia genera flourish in the town. The difficulties in the way of progress in eradicating their breeding places are enormous, and at times the situation seems to be almost hopeless. The profoundly dilapidated condition of the majority of the premises in the town is responsible for over half of these mosquito breeding places. Defective roof gutters, ill-paved yards, badly laid drains, ruinous masonry work, flooded cellars, to mention only a few, render the detection of such places difficult and their elimination tedious.

In addition to the above-mentioned genera, one Anopheline, *A. costalis*, is also to be found to some extent within the municipal boundary. This is partly due to the fact that there are many vacant plots and waste areas in the town so that some parts resemble open country with only occasional houses scattered over a comparatively wide area, while another reason is that the mosquito appears to have become, to some extent, domesticated, inasmuch as its larvæ are to be found somewhat widely distributed in the typically urban portions of the town, in odd pools, on paved drains and in other small collections of standing water.

Plague.—The septicæmic and pneumonic forms are almost always fatal. Cases of plague have been detected in Port Louis throughout the year, although the largest number of cases occurred during the hot weather.

Plague Prophylaxis.—As a routine prophylactic measure, mass inoculations with anti-plague vaccine were practised. The work done in this respect is summarized herewith.

Rat-proofing of houses was begun in November, and it is hoped that as the work progresses there will be a proportionate diminution in the number of plague-infected areas in the town.

Rat Fleas.—During November and December some sixty fleas were collected from Port Louis rats. With the exception of three defective specimens that could not be identified all of the insects resembled *Xenopsylla cheopis*. *X. astia* has not yet been encountered in Port Louis, but the work of collection and examination will be continued with a view to ascertaining whether *X. astia* exists here or not.

Twelve of the specimens were found in a wooden bin containing rice in a grocer's shop. Plague-infected rats had been found previously upon the premises which were fumigated by burning sulphur in open burners as a disinfestation measure after disinfection. When the premises were opened up after fumigation the fleas were found to be apparently unaffected by the gas, although roaches had been killed off in large numbers. It is possible that the gas had failed to penetrate the air spaces between the individual grains, which retained sufficient oxygen to tide the fleas over the period of fumigation, while the larger insects whose oxygen demands were presumably greater succumbed, even although they are notoriously more difficult to kill than fleas. Following upon this interesting observation, steps were immediately taken to revise the technique of fumigation by sulphur with a view to making it more effective.

Anti-Rat Campaign.—During the year 55,273 rodents were destroyed and submitted to microscopical examination for plague infection. 534 of the total number of rodents examined were found to harbour the *Bacillus pestis*.

The means taken for the destruction of rodents were: (*a*) poisoning by poisoned baits; (*b*) trapping in spring and cage traps; (*c*) trapping by means of "glue-boards."

The glue boards were employed originally at the suggestion of Dr. Balfour, and they have given such satisfaction that their use has been gradually extended. One great advantage of the glue board is that it captures a great proportion of the rat fleas as well as the rat itself and so limits the spread of infection. Owing to a temporary shortage of imported rat varnish, it was necessary to attempt to manufacture a substitute locally. After several experiments a very satisfactory lime was produced. The method of manufacture is as follows: heat two litres of boiled linseed oil, and when the oil has boiled for thirty minutes, add five kilos of powdered resin in small quantities, stirring all the time. The stirring and heating are continued for about half an hour, by which time the mixture should be of the required viscosity—as determined by trial. It is then ready for use.

Enteric Fever.—The figures, which include notifications under the term "continued fever" showing the incidence of fevers of the "enterica" group, throughout the year amount to fifty-eight cases, deaths nineteen.

It would be unduly optimistic to suppose that these figures give a true picture of the case incidence of the disease. It is almost certain that many mild cases escape notification on account of the fact that a qualified medical practitioner is seldom called in to see the patient, or, if he does happen to be summoned, is given little real opportunity to make a diagnosis of the malady.

It has been practically impossible to determine the origin of the cases. There has been no evidence brought forward to incriminate the milk supply. The detection of carriers will always be an unnecessarily difficult matter so long as there is an

absence of proper laboratory facilities in Port Louis itself.

In the absence of definite evidence to the contrary it has been thought that the water supply has been the medium of spread of the infection. An improvement in the quality of the water supply should therefore reduce the case incidence and the death-rate from this group of fevers. The "residual typhoid" will be then more easily investigated and with better prospect of success.

School Medical Inspections in Port Louis.

The principal diseases noticed were: pediculosis, scabies, skin diseases, defective eyesight, ear troubles, tonsils and adenoids, bad teeth, rickets, malaria, ankylostomiasis, schistosomiasis and other worm infection.

The number of pupils examined amounted to 4,498.

The figures show a decided improvement as regards the number of children affected with pediculosis, malaria, ankylostomiasis and other worm infections.

The number of children affected with ear troubles and inflammation of the tonsils has increased in a marked degree owing to the presence of influenza which prevailed during the second half-year. The number of children affected with scabies has also increased.

The figure for malaria shows, I am glad to say, a considerable decrease, this in spite of the heavy and continuous rainfall we have had during practically the whole period under review.

The figure for ankylostomiasis also shows a marked decrease, due very probably to the effective measures taken by Dr. Hampton, who so devotedly treated in the schools of Port Louis all the children affected with that disease.

It must be borne in mind that this heading comprises all cases of anæmia detected among the children during my inspection, irrespective of the cause or causes which might have brought that condition, that is to say, enlargement of the spleen, general debility, defective development, worm infections and poverty.

The figure for schistosomiasis is about the same.

There is a marked decrease in the figure for other worm infections, due very likely to the treatment applied for hookworm by Dr. Hampton.

343 pupils were found with enlarged spleen.

On the whole and notwithstanding the favourable climatic condition for the spread of malaria which prevailed during a greater part of the time between February and June, a marked improvement, calculated on sufficient data, has been registered as regards the decrease in both the percentage and the average spleen noticed during this first half-year.

Anti-Malaria Work in Plaines Wilhems.

In Curepipe, seventeen cantonniers under a moustiquier have carried out the usual cleaning of the existing channels and rivers.

Several ponds and marshy places have been filled up. *Anopheles costalis* have been found from time to time. *A. funestus* and *A. maculipalpis* have not been found.

A. mauritianus is frequently met with in the forest grounds and in springs and marshes which are so common in Curepipe.

In the Quatre Bornes Section, both *A. costalis* and *A. maculipalpis* have been found in Candos Mountain drains and in the neighbourhood of Mount Corps-de-Garde, and in the intervening area between these two points—twelve cantonniers and a moustiquier carry out this work.

In Beau Bassin and Rose Hill there are no works directly carried out by the department. *A. costalis* have been found in roadside gutters, in various water nuisances arising from the defective drainage channels from irrigation canals and broken water pipes and defective public fountains. These latter defects are common to all sections as are also defective "prises" and "regards." The irrigation canal work is the duty of Syndics and private owners and recourse has to be made to the Law Courts to effect repairs.

Plague.

The outbreak of human plague in Plaines Wilhems synchronized with the discovery of rat plague. The latter proved to be very extensive. The commencement was in October and human plague continued till the end of February. Two estates were attacked, viz.: Highlands and Ebène—fortunately, three and two cases respectively were all that occurred in them. In Ebène, many rats were found in storehouses and quantities of fleas were found in gunny sacks and cereals.

The prophylactic measures besides disinfection, the liberal use of paraffin and soap emulsion on floors, segregation of patients and contacts and observation of neighbours, included vaccination and control of deaths.

Over a hundred deaths were controlled by spleen, liver and lung punctures. In five cases the disease had not been suspected or certified as plague during life.

The type of native hut and cow shed built of loose stone, walls and superstructure of thatch is a real menace in urban areas. Many plague rats were found in these buildings. There is no doubt that plague is really endemic in these places and recrudescences of human plague must occur under the conditions referred to.

Many orders have been served for shops and houses (concreting of floors and repairs to make rat-proof) throughout the district.

Eight thatch houses were burnt in Planes Wilhems in connection with plague in 1923.

103 cases of infectious diseases occurred in Plaines Wilhems in 1923, i.e., enteric fever, diphtheria, septicæmia, puerperal fever, erysipelas, cerebro-spinal fever, measles, and whooping-cough with enteritis.

Annual Report of the Bacteriological Laboratory for the Year 1923.

The number of specimens and articles received at the Bacteriological Laboratory during the year 1923 totalled 3,014, showing an increase of 1,164 on the number for the preceding year. They may be classified as before, for facility of discussion, under the following heads:

Clinical.

The samples coming under this head, exclusive of vaccines, amounted to 2,356. Of these 203 were submitted to bacteriological examination involving cultures and animal tests when required. The materials dealt with comprised blood, throat swabs and false membranes, sputum, fæces, pus and pathological exudations, urine, cerebrospinal fluid, neoplastic growths, &c.

(*a*) *Blood.*—1,077 samples were examined.

Malaria.—217 samples came in for this disease. Parasites were found in twenty-one cases as follows: subtertian in eleven, tertian in nine, quartan in one.

Filariasis.—Eighteen samples were examined for filaria embryos; *Microfilaria bancrofti* was found in four.

Plague.—Plague bacilli were discovered in four out of eleven smears of gland or spleen juice from suspected cases. None were found in a sample of blood from a similar case.

Typhoid and the Paratyphoids.—These diseases accounted for 350 specimens. 288 of these were submitted to Widal's test for agglutinins with positive results (one in thirty and higher dilutions) in ninety-two cases. Blood culture on bile-salt broth was done in seventy-two other cases with success in fourteen.

Syphilis.—261 samples were tested for the Bordet-Wassermann complement fixation reaction. Positive findings were obtained in ninety-two and doubtful ones sixty-six instances. The antigen used is prepared from human heart muscle.

Blood counts.—Ninety-three differential leucocyte counts were made and one red corpuscle count.

Chlorides and Urea.—One sample was sent in for a quantitative estimation of chlorides and eighty-nine for a quantitative estimation of urea.

Malta Fever.—Agglutinins for *M. melitensis* were looked for in the blood of a patient suspected to be affected with this complaint, but the reaction proved negative.

Bacteriological examinations.—In the seventy-five cases in which a blood culture was made fourteen yielded *Bacillus typhosus*, seven yielded streptococci, four yielded staphylococci, two yielded *B. coli communior.*

(*b*) *Throat and nose swabs* were received on seventy-two occasions. The Klebs-Löffler diphtheria bacillus was found on thirty-six and Vincent's fusiform organism on thirteen, with or without other bacterial associations.

(*c*) *Sputum.*—Samples received 168. Examined principally for Koch's tubercle bacilli and pneumococci. The former were present in thirty-seven and pneumococci in predominating numbers in four.

(*d*) *Pus.*—Number of samples seventy-eight. The materials were derived from abscesses, boils or were specimens of urethral or vaginal discharges. Gonococci were found in three, while twelve samples of closed abscesses proved sterile. Of the twenty-eight specimens that were successfully cultured, twenty-one gave staphylococci and seven streptococci.

(*e*) *Cerebro-spinal Fluid.*—Specimens examined twenty-nine. Four came in for a Wassermann test of which two gave positive results; the colloidal gold reaction was applied to seven others, positive in six instances; a leucocyte count was made with three samples while three others were tested quantitatively for albumin and one for glucose. Eleven more were examined for their bacterial contents: four showed pneumococci and one meningococci. Six were free from micro-organisms.

(*f*) *Pleural Fluid.*—Four samples were received, two for cytological study and a leucocyte count and two for bacteriological investigation. From one of these a streptococcus was isolated.

(*g*) *Cystic Fluid.*—The liquid contents of a cystic tumour of the foot were examined and cultured without results.

(*h*) *Bile.*—A sample was tested for micro-organisms of the typhoid group, with negative results.

(*i*) *Hydrocele Fluid.*—Search was made unsuccessfully for filaria embryos in the tappings from a case suspected to be of filarious origin.

(*j*) *Synovial Fluid.*—No micro-organisms could be demonstrated either by microscopical examination or culture in a case of synovial effusion.

(*k*) *Hairs.*—A number of specimens were received and examined for fungi.

(*l*) *Fæces.*—Samples 488. *Amœba histolytica* present in forty. Other entozoa were also found in the course of these examinations, i.e., trichuris, ankylostome, ascaris, trichomonas, blastocystis, lamblia, anguillula stercoralis, oxyuris and coccidia.

The coccidia were found in diarrhœic stools in association with no other known pathogenic organism. No alternate cause could be found for the recurrent attacks of diarrhœa from which the patient was suffering and there seemed to be good grounds for incriminating the coccidia. In fresh stools only ovoid oöcysts were seen with undifferentiated granular contents, but after standing for a few days the oöcysts were found to have developed two sporocysts containing four sporozoits each. In short, the organism closely resembled the sexual form of *Isopora hominis*. Treatment proved of no effect. It is the first case of human intestinal coccidiosis registered at this laboratory. The patient had been abroad some time previously so that the infection may have been acquired out of the colony.

Six samples of stools were cultured: from two *B. coli communis* (Escherich) and from a third *B. coli communior* were isolated.

Colonial Medical Reports.—No. 171.—Mauritius (*contd.*)

(*m*) *Urine.*—413 analyses were made. Most of these consisted of the usual routine clinical procedures, chemical and microscopical, but in sixty-seven cases the centrifuged sediments were cultured with the result that staphylococci were isolated, also *B. coli communis*, *B. lactis aerogenes*, *B. coli communior*, *B. paracoli*, streptococci, one diphtheroid bacillus, one Gram-negative unidentified organism, and twenty-four sterile.

Microscopical examination of the sediments also showed eggs of *Schistosoma hæmatobium*, hyaline casts, granular casts, waxy casts, filaria embryos, gonococci and trichomonas.

(*n*) *Neoplasms.*—Sixteen specimens were cut and sections examined. They consisted of fibroma, fibro-sarcoma, sarcoma, myxoma, carcinoma, epithelioma (squamous), papilloma, bilharzia polypus, salivary gland (normal). In addition, portions of muscle tissue were also examined for trichinæ with negative results and sections were made of the heart muscle, kidney and lung in a case where fatal poisoning with carbon tetrachloride was suspected.

(*o*) *Catgut.*—Complaints having arisen regarding the quality of the catgut supplied to the hospitals, an investigation was undertaken by this laboratory in the course of which eight different specimens were bacteriologically examined, all but two of which showed a contamination with a spore-bearing bacillus or a small Gram-negative organism, or with both.

VACCINE.

(*a*) *Prophylactic Vaccines.* — Antityphoid and T.A.B. vaccines were prepared as before for prophylactic purposes and issued free of charge. 866 applications were received from the former, but the demand for the compound vaccine was much smaller, being limited to 180 persons.

(*b*) *Therapeutic Vaccines.*—The following autovaccines were prepared, from blood: with *B. coli communior*, *B. typhosus* and *streptococci;* from urine: *B. coli communis*, *B. coli communior*, *B. lactis aerogenes*, *B. paracoli* and *staphylococci;* from pus: staphylococci, streptococci; from fæces: *B. coli communis* and *B. coli communior.*

Spleen smears from seventeen rats were examined for the sanitary authorities with positive findings as to plague in two instances.

RESEARCH.

Work done under this head comprised:

(*a*) A continuation of the previous searches for the intermediate host of *Schistosoma hæmatobium* in Mauritius.

(*b*) The application of micro-spectroscopy to the determination of blood stains for medico-legal purposes.

(*c*) A study of human intestinal coccidiosis.

Colonial Medical Reports.—No. 172.—Madras.

ANNUAL REPORT OF THE HEALTH OFFICER OF MADRAS FOR THE YEAR 1923.

VITAL STATISTICS.

A marked feature in the climatic conditions of the city during 1923 was the abnormal drought caused by the scanty rainfall, the total rainfall for the year being 37·33 in.

The number of births registered during the year 1913, exclusive of still-births, was 22,975.

The number of deaths registered during the year, exclusive of still-births was 19,933. The number of deaths registered among Europeans was forty-three, Anglo-Indians 288, Indian Christians 886, Hindus 16,324, Mohammedans 2,388 and others four. These figures are somewhat interesting in that they show that the healthiness or otherwise of any community is largely influenced by the social and economic conditions under which they live.

CAUSES OF MORTALITY—INFECTIOUS DISEASES.

Malaria causes 3·9 per cent. of the total deaths.

There were fifty-one deaths from enteric fever during the year.

Fifty-two deaths from kala-azar were registered from this cause.

Fifty cases of cholera were reported in a sporadic form during the year, of which twenty-one proved fatal.

The incidence of this disease was greater in the months of August and December than in any other month of the year. The following special steps were taken to prevent any possibilities of spread of infection from the disease: (1) The private medical practitioners in the city were informed through the press that they might send patients suffering from cholera or small-pox at an early stage to the infectious diseases hospitals at Rayapuram or Krishnampet and attend upon and treat the cases themselves at the said hospitals. (2) Two sub-assistant surgeons in each range were given training in Roger's method of treating cholera cases so that they might treat the cases at the residences of the patients, whenever necessary and whenever there might be a regular outbreak. (3) Pamphlets on "Cholera and Flies" in English and Vernacular were printed and distributed broadcast to the public. (4) Posters about cholera were put up at public places.

Small-pox was prevalent in the city throughout the year in a sporadic form, the number of attacks during the year was 481, of which 151 proved fatal.

Suitable preventive measures were taken and the disease was greatly kept under control.

There were twenty-five deaths from measles during the year.

The total number of deaths registered under influenza was nineteen for the year.

There was one attack and one death from an imported case of bubonic plague against one attack and one death in 1922.

3,778 deaths were recorded during the year from diarrhœa and dysentery.

Diarrhœal diseases are almost entirely water-borne and a fall in their incidence can only follow in proportion to the improvements that can be effected to purify our water supply and the control we can exercise upon the sale of articles of food and drink.

3,342 deaths were registered from general respiratory diseases, excluding tubercle of the lung.

1,268 deaths were registered under tuberculosis, including tubercle of the lung, an increase of 180 deaths to the previous year. Diseases due to infection by tubercle bacilli appear to be on the increase. The figures available in statistical tables may not represent the whole truth. For, on the one hand, in the wide group of tubercular infections that affecting the lungs is alone made notifiable since 1920, while, on the other hand, the notifications received do not reveal the exact number actually suffering from tuberculosis of the lungs. Although it may be argued that the presence of the Tuberculosis Hospital and Institute in the city attracts a good number of cases from the mofussil and, therefore, the rise so far as this city is concerned is only apparent, yet the general consensus of medical opinion seems to agree that the disease is actually on the increase. The remedy is to segregate in the house as best as possible all open cases of lung tuberculosis, i.e., patients who throw out a large number of active bacilli in their sputum and to relieve overcrowding and poverty. What is needed is a general scheme for prevention of tuberculosis for the whole presidency if the city should be saved from its ravages.

2,040 deaths were registered under diseases of the nervous system. Of these, 1,440 deaths were recorded among infants under one year of age.

During the year there were sixty-two attacks and two deaths from relapsing fever which was prevalent for about five months from December, 1922, amongst the chucklers and scavengers. The disease was brought under control, each case being immediately removed to the Infectious Diseases Hospitals for treatment after examination of the blood for the presence of spirochætæ and the patient was promptly treated with neosalvarsan given intravenously. The bodies and clothing of contacts were cleansed and freed from verminous conditions so largely prevalent amongst that class of people.

Vaccination.

Vaccine lymph for the operations was obtained from the King Institute of Preventive Medicine, Guindy. The total number of vaccines performed during the year 1923 was 36,629. The number of revaccination cases has perceptibly decreased, consequent on the absence of an epidemic of small-pox, while primary vaccinations have shown a rise and this, in fact, is the real index of vaccination work.

Of the total number of primary vaccinations (17,900), 15,899 were among children under one year of age.

The total number of births verified during the year was 17,217. Of them, 3,453 died during the year.

Sanitation.

Water Supply.—As a result of discussions in the Council in respect of the quality of water supplied to the city, an analyst was appointed to examine and report on it. A laboratory was constructed at Kilpauk within the water-works compound to facilitate the examination of samples of water at various stages of its purification. The report of the analyst in this behalf is appended. The report indicates that the water supplied to the city is far from pure and water after undergoing filtration does not attain to a sufficient standard of purity either chemically or bacteriologically as to make it all wholesome. Unsatisfactory as this may be, the matter is receiving due consideration at the hands of the corporation. Since my annual health report for 1922 was written, the Government Water Filtration Committee submitted their report to the corporation, who, after a discussion at one of their meetings, referred the question back to the government for a further report by the said committee and for obtaining the expert advice of Colonel Clemesha, I.M.S. (retired). Pending the receipt of these reports, the corporation have not been in a position to launch upon further schemes for effectively purifying the city water supply. In the meantime the best and safest course for the people to do is to collect the water from the tap after passing it through a thick piece of cloth and boil and cool all that part of it at least which is used for drinking.

Drains.— It is the duty of the Health Department to advise the Works Department to construct and maintain drains for the efficient carriage of sewerage and sullage in certain localities where they are likely to improve the sanitary environments. Drains were accordingly constructed.

Streets.—Certain important streets and thoroughfares in the city are now being tarred and a great deal of nuisance from dust is thus abated. There yet are several important and busy localities where nuisance from dust is a real danger from the public health point of view. It seems necessary to extend the refining of roads so as to make them dustless even at some large initial cost. Dirt and dust are true breeders of disease and they should be allayed by all practicable means.

Control over Waters.—Municipal control over tanks and wells cannot at present be said to be satisfactory. It is a well-known fact that there are a number of public tanks which are kept in a bad state so as to be a source of nuisance and

danger to public health. During the year action was taken in respect of sixty-one cases to get the tank or well cleaned up. But this is very inadequate as there are many large tanks in the city which act as breeding places of mosquitoes. It has been proved that many wells in George Town breed the type of mosquito that carry malaria to man. Control over waters and waterways in these days is called for mostly for anti-malarial purposes. That Madras is an endemic area for malaria and that there are plenty of breeding grounds for mosquitoes have been amply proved by an investigation consequent on the outbreak of malaria in an epidemic form in 1912 and 1913. The corporation started with the assistance of a government campaign against malaria which continued to work on actively till April, 1921. Since the latter date it was practically given up on financial grounds and except for a small set of nine coolies and a Maistri for cleaning the anti-malarial drains the whole establishment was abolished. As at present, before action could be taken under Section 264 regarding these places we have to satisfy ourselves that mosquitoes do breed and that they are carriers of disease. This would require a special staff to investigate from time to time. Anti-malaria work such as oiling and cleaning, removing weeds, &c., requires a special set of men trained for the work and the corporation must maintain a set of these coolies for this purpose. Private tanks, wells and pools are so numerous in the city and so insanitarily kept that some method of controlling them and keeping them sanitary is immediately called for. It is suggested that these places may be licensed by the department, so that we could have a control over the owners, to make it obligatory on their part to maintain them in good condition and the corporation could get the necessary work done from time to time by sending out the special staff and recovering a fee for the work done. The difficulty is that even if we take action under the Madras Municipal Act owners of tanks and wells, &c., cannot find and procure the trained labour for this kind of work. The Cooum and the Buckingham Canal continued to be in the same condition as recorded in my last report. It is the duty of the Government Public Works Department to remove silt from these from time to time and keep them clean. They require greater attention at their hands than at present. The corporation cannot at the same time relieve themselves of their responsibility in the matter, as a fair and considerable proportion of sewage is let into these water channels at various points of their course through the city. This can be stopped only when the city is completely sewered.

Disinfectants.—Hycol and chloride powder were the two disinfectants chiefly used during the year.

The medical officer of the Krishnampet Isolation Hospital and others delivered lantern lectures on small-pox and other subjects in the various parts of the city during the course of the year.

In pursuance of the resolution of the council at its general meeting held on February 20, 1923, the work of medical inspection of the elementary schools under the corporation of Madras was entrusted to the medical officers in charge of the twelve corporation dispensaries.

Hospitals and Dispensaries.—Two infectious diseases hospitals, one at the Old Jail Road and the other at Krishnampet, continued to serve a useful purpose and were in charge of sub-assistant surgeons. The latter has accommodation for ninety beds. The motor ambulance was in use during the greater part of the year. These hospitals are increasing in popularity. The new infectious diseases hospital at Tondiarpet is under construction.

The dispensaries were in charge of sub-assistant surgeons. Owing to the usefulness of these institutions four more dispensaries were opened during the year at Nungambakam, Mannady, Mafuskhan Garden and Mint Street. The proposal that a municipal dispensary might be made a unit of registration and vaccination district was sanctioned by the council and accordingly provision was made in the current budget for three more dispensaries.

These institutions were largely attended by the middle and poor classes of people residing in and about the place where they are located.

Report on the Work in the Corporation Water Analysis Laboratory for 1923.

Laboratory work as organized at present is chiefly of a routine nature and consists of: (1) Preparing media for bacteriological work (nutrient agar, nutrient broth, MacConkey's agar, MacConkey's broth, sugar media for water analysis, strong peptone water for cholera work, weak peptone water, glucose medium for Voges and Praskaur's reaction and Aronson's medium for cholera work). In addition, sterilization of pipettes, bacteriological sample bottles, Petri dishes, &c. (II) Collection of bacteriological and chemical samples, three per day and even more occasionally. (III) Bacteriological analysis (total colonies count in 1 c.c. of sample, inoculation of tubes of MacConkey's bile salt broth with various quantities of water, vibrio test in 100 c.c. of the test tap sample and microscopic examination of sediments). (IV) Chemical examination, qualitative consisting of colour and transparency, smell, nitrite, nitrate and sulphate, &c., and quantitative examination, consisting of ammoniacal nitrogen, albuminoid nitrogen and absorbed oxygen (Tidy's). (V) Any other work which the health officer or the special engineer through the health officer may suggest.

Analysis of the raw water shows that its organic content as represented by the "ammonias" varies considerably. The figures for "ammoniacal nitrogen" and "albuminoid nitrogen" vary between a trace and 0·004 in the former case and 0·030 to 0·048 in the latter case. The results of bacteriological examination show that lactose fermenters are present in as small a quantity as 1 c.c. and upwards in 59 per cent.; in 5 c.c. and upwards in 30 per cent.; and in 10 c.c. and upwards in 11 per cent. of the analyses, the average total number of colonies per c.c. being about 1,200.

The filter beds yield, at times, filtrates of good quality or of fair quality; and at other times of a quality which shows no improvement over raw

water. The results of filtration as judged by the chemical examination of samples of water are not satisfactory. A smell of sulphuretted hydrogen was noticed in the regulator chambers of the filter beds, on almost all occasions, the intensity of the smell varying during different seasons of the year. This odour was present throughout the year and was more conspicuous in summer than in other seasons of the year. In the case of "free ammonia" variations between a trace and 0·019 are to be found. The figures for "albuminoid nitrogen" and "absorbed oxygen" are also excessive.

Vibrio Test.—On August 30, 1923, the analyst was asked to make bacteriological tests with special reference to the presence of cholera or cholera-like sprillum in water sent to the town supply, as there were a few cases of sporadic cholera in the town. Samples from the test tap on the main which leads to the city supply were specially tested for vibrios and the examination showed negative results. Since then testing for vibrio in the town supply has become a part of the routine work of the laboratory and on no occasion during the year under review the presence of cholera or cholera-like vibrios was detected.

Microscopic Examination.—Systematic examination of suspended matter in raw water and of the "filtering skin" or "schmutzdecke" every time a filter bed was scraped was made under the microscope.

Growths of Organisms in the Covered-in Masonry Conduit.— About January 21, 1924, the cleaning of the conduit was started. Till about the 15th manhole there was no thick growth of any kind excepting some water insects which were found adhering to the sides of the wall above the surface of water. Abundant growths of a brown colour were seen after the 15th manhole, sometimes covering a length of ten to fifteen feet, and often in discontinuous patches, whose thickness varied from ¼ in. to 1 in. The same growth was found to extend to the Kilpauk end of the conduit. It grew under water, on the sides of the conduit. Samples of the stuff were collected and were identified to be a polyzoon by Dr. Gravely of Madras Museum, who sent it to Dr. Anandale, the leading specialist in the group, for identification of the species. It was found to be *Plumatella* (Afrindella) *tanganyikæ*, Rousselet, a not uncommon species in India. Imbedded in this there was also plenty of epistylis. The sample contained, in addition to plenty of statoblasts of plumatella, anguillula, water flies, &c.

It may not be out of place here to give an account of the family of polyzoa.

"The family of polyzoa is one of the most interesting branches of the animal kingdom. The massy growth consists of branched tubules growing from a common stem in the form of a living tree. Each branch is inhabited by a complete animalcule provided with mouth, stomach, rudimentary alimentary canal and genital organs. Its prey consists of micro-organisms, bacteria, &c., which are swept into the mouth by the movements of an array of tentacles which are protruded at intervals in the water. The whole form a colony of individuals housed in the branches of a common zoological tree, which is itself alive. Polyzoa are most fascinating objects to watch under the microscope."

Miscellaneous Work Done During the Year.—(*a*) In September the special engineer desired the analyst to make qualitative tests for the smell evolved in the regulator chambers of the filter beds, as, in his opinion, the odour varied from "earthy" to SH_2 smell. Accordingly, several qualitative tests were carried out which conclusively proved that the smell was of sulphuretted hydrogen. One of the tests was the lead acetate test. Filter papers soaked in an alkaline solution of Pb $(C_2H_3O_2)_2$ were suspended about a foot over the water in the filter chambers. They were collected next morning and the results were recorded.

(*b*) Experiments on the correct dosage of chlorine and the minimum period of contact for producing sterility on the effluent from the "double filter."

The analyst carried out these experiments. The first portion was done according to Sims-Woodhead Field test modified by Morrison and the latter portion of the experiments was carried out as follows: The dose of chlorine for the effluent from the "double filter" was determined by "Field test" first. Next, six different beakers were taken, each containing 500 c.c. of the effluent and to each was added requisite amount of bleaching powder solution, corresponding to the dose of chlorine, previously determined by "Field test." After the addition of the bleaching powder solution, all the beakers were stirred by glass rods, so as to have a homogeneous mixture. The first beaker was allowed ten minutes contact, next twenty and the last sixty minutes contact. After the end of each period, a set of MacConkey broth tubes were inoculated with water from the respective beakers and incubated for forty-eight hours at 42°C. The results at the end of forty-eight hours were recorded.

The dose of chlorine for raw water varied from 0·8 to 1·0 part per million, while that of the effluent from the "double filter" from 0·7 to 0·8 part per million. The minimum period of contact for producing sterility on 500 c.c. of the effluent from the "double filter" was 10 minutes.

Report on the Medical Inspection of the Corporation Elementary Schools.

The most striking fact that emerges from the examination is the prevalence of infectious or contagious diseases including skin affections and of tuberculosis, viz.: 2·01 per cent. and 0·32 per cent. respectively of the boys examined. What need to be done in regard to these children are these: absolute exclusion of those suffering from such diseases as leprosy and infectious or contagious disease, especially of skin and of open tuberculosis, i.e., cases in which sputum infected with tubercle bacilli is expectorated; advice to parents for treatment of such cases, either in hospitals or elsewhere, and examination of all children before admission to schools by the medical inspectors.

Colonial Medical Reports.—No. 173.—Ceylon.

REPORT OF THE PRINCIPAL CIVIL MEDICAL OFFICER AND INSPECTOR-GENERAL OF HOSPITALS FOR THE YEAR 1923.

Public Health.

181,441 births were registered and 141,894 deaths during the year.

The more notable causes of death were the following disease: Infantile convulsions, diarrhœa, pneumonia, rickets, intestinal parasites, anæmia, dysentery, phthisis, dropsy, malaria, ankylostomiasis and its *sequelæ*, puerperal septicæmia, enteric fever, tetanus, rabies and deaths attributed to pyrexia of unknown origin.

A large number of the deaths registered under pyrexia of unknown origin were undoubtedly due to malaria or diseases concurrent with it, as this disease was very prevalent in the greater part of the island.

Infantile Mortality.—16,166 deaths from infantile convulsions were registered during the year, and this number represents 11·39 per cent. of the total number of deaths registered, which indicates the need for child welfare centres and créches, antenatal clinics, and trained midwives. Some endeavour to aid mothers in the care of their infants is being made in the larger towns by social service circles.

Malaria was very prevalent and showed a marked increase as regards hospital admissions, and cases treated at dispensaries and hospital out-patient departments over the large numbers of the previous year. 2,118 deaths from malaria were registered in 1923; but 23,328 deaths in 1923 were registered under pyrexia of unknown origin. Many of these were probably due to malaria.

Quinine to the value of Rs. 276,120·96 was issued free for preventive and curative purposes. It was distributed by itinerating apothecaries and vaccinators on fever duty and by headmen through the Government Agents during the fever seasons.

Education and Propaganda.—Public lantern lectures in English and the vernaculars have been given at Anuradhapura, Badulla, Trincomalee and Gampaha, and lantern lectures and demonstrations at schools at Badulla and Trincomalee. An extensive series (about eighty) lantern slides of local application, and several posters, illustrating the more important facts and principles underlying modern methods of prevention and control, have been prepared during the past two years. These slides and posters should prove of considerable educational value, and should be of great service in the future, when malaria propaganda work is definitely organized. Several thousand pamphlets and handbills on malaria have been distributed to towns and villages in various parts of the Island. A malaria exhibit was sent to the Agri-Horticultural Show at Gampaha in July, 1923. This exhibit included a complete series of the anopheles mosquitoes found in Ceylon with enlarged paintings of the commoner and more dangerous malaria carrying species, living malaria and non-malaria-carrying mosquitoes and their larvæ, larvivorous fish (imported and indigenous), and various other specimens of general interest; also photographs and paintings of anopheles breeding places and malaria parasites, maps, posters, diagrams, &c.

A course of lectures and demonstrations on malaria and its control was given during April and May to the Training Class for Sanitary Inspectors held by the Sanitary Branch of the Medical Department.

A useful and instructive pamphlet on malaria was prepared by Dr. L. Nicholls for the use of teachers, and was published by the Department of Education; it has been widely distributed to schools and also to the general public.

Malaria Research and Control Works.—Research work in connection with malaria was continued on the lines indicated in the report for the year 1922. Detailed malaria surveys of the four centres mentioned above and of Trincomalee were completed, and further inquiries instituted into the bionomics and seasonal prevalence of anopheles and other factors influencing the incidence and spread of the disease at these towns. Other investigations included continuance of the work on paddy cultivation and malaria as detailed in the previous report, and an attempt to determine the reasons for the relatively low incidence of malaria in the south-west portion of the island. The results obtained from observations on the breeding of anopheles mosquitoes in paddy fields made throughout a completed year appear to be of sufficient interest and importance to justify an extension of the work. It has, however, been found impracticable to continue examinations every month at all the towns originally selected, and accordingly the work has been restricted to the five centres at which assistants are stationed.

Additional and more precise information relative to the various investigations has been obtained, but since in many aspects the separate lines of work are interconnected, and complete results are not in all cases available, it is considered advisable to defer further discussion to the final report referred to above. Much of the laboratory work connected with these investigations is performed in Colombo; it involves a large amount of routine examination work, particularly during the period of the north-east monsoon, and throws a heavy strain upon the

staff. The inquiries in progress relative to the bionomics, distribution and prevalence of anopheles mosquitoes are largely quantitative in nature, and are for the most part based upon the larval stage of these insects. During the past year such routine work alone has involved the microscopical examination of an average of 4,400 anopheles larvæ per month and a total of 1,448 blood films.

Further collections of larvivorous fish have been made and are awaiting identification. *Haplochilus lineatus*, the species occurring so abundantly in the swampy areas of the Western and Southern Provinces, has now been found in large numbers in swamps and flooded paddy fields on the east coast in the Batticaloa, Trincomalee and Mullaittivu Districts. With the exception of the last-named places the species has been rarely found in the dry zone of Ceylon. Attempts to establish it in the nurseries, for subsequent distribution to wells and non-permanent pools in districts where malaria is intense and larvivorous fish relatively scanty, have not proved very successful. Much more promising results have been obtained with the West Indian species *Gambusia affinis*—" Millions "—which is not only more voracious and prolific, but less susceptible to changes of environment. With care and attention " Millions" should eventually become established throughout the greater part of the island, when their periodical distribution to wells and non-permanent pools should afford a valuable measure of control. Additional nurseries for both species were opened at Jaffna in September; *Gambusia* increased sufficiently in numbers to allow of their initial distribution in November to wells in which *Anopheles* was breeding Distribution of " Millions " to wells and pools was also carried out at Talaimannar and Trincomalee during the last few months of the year.

Malaria control measures have been in operation during the past year at Anuradhapura, Trincomalee, Mahara Jail, Kurunegala and Badulla. The campaigns at Anuradhapura and Trincomalee are intended to serve as demonstrations and it is hoped will indicate the nature and value of anti-malaria works in the low country; they are under the control and direction of this office, but are conducted in close co-operation with the local authorities, who also assist financially. At Mahara Jail, where a serious epidemic occurred in 1921, the works recommended have been carried out under supervision of jail superintendent and the resident medical officer; the results for the past year have been satisfactory, and a continued steady drop in the curve for hospital admissions for malaria has taken place since May. At Kurunegalla and Badulla anti-mosquito measures of a minor nature have been performed by the local authorities, but it is doubtful whether such measures alone can produce any marked effect upon the incidence of malaria. At both of these towns the work is greatly handicapped by lack of funds, and—of equal importance—a trained staff to direct and control initial measures.

Cholera.—There has been no outbreak of cholera in the island for three years. The last case occurred in 1920

Small-pox.—There was an outbreak of small-pox in Kandy at the end of the previous year, and the disease was carried to several centres of infection during the first quarter of the year by absconding contacts. 200 cases with thirty-one deaths were reported from the Central Province, twenty-six cases with two deaths from the Western Province, five cases with one death from the Province of Sabaragamuwa, and one case from the North-Western Province.

Five cases were landed in Colombo from steamers, and three cases occurred in Colombo town, with one death.

There were 240 cases with thirty-five deaths.

Vaccination.—The total number of primary vaccinations performed during the year was 138,092; of these, 124,462 were successful and 1,859 were failures. In 11,771 cases the results were not determined.

Government Vaccine Establishment.—The officer in charge reports 480 calves were received on hire from the contractor; 474 calves were used for vaccination during the year; and of these, 466 were returned.

Seed lymph for the vaccination of calves was obtained from the Lister Institute of Preventive Medicine, London, and from the King Institute, Madras; and was also prepared locally. 160,593 tubes of calf lymph were issued from this establishment during 1923.

Enteric Fever.—The total number of cases treated in Government hospitals during the year was 921, with a death-rate of 29·31 per cent. Patients are usually taken to the hospitals for admission in late stages of the disease and the mortality rate is therefore high. These figures do not indicate the extent to which enteric fever prevails in towns and rural districts generally. Probably many cases occur which are neither recognized nor reported. The Registrar-General's returns show that 597 deaths from enteric fever and 23,328 deaths from " general fever " (pyrexia of unknown origin) were registered during the year, and undoubtedly some of the latter should have been included in the former.

Diphtheria.—This disease rarely occurs in the island. Only fifteen cases with six deaths were recorded during the year; and of these, eight cases were treated in the Infectious Diseases Hospital, Colombo.

Influenza.—A mild form of influenza prevailed in all the provinces at different periods of the year. 4,443 cases were treated in Government hospitals with 162 deaths, a mortality rate of only 3·64 per cent. 23,372 cases were treated at dispensaries during the year.

Dysentery.—There were outbreaks of dysentery in the Western and Southern Provinces, and this disease was unusually prevalent during the year, due probably to the abnormal rains. The number of cases treated in Government hospitals was 5,884, with 993 deaths. 25,516 cases were treated at dispensaries during the year. The most common source of infection is the drinking water, which is only obtainable, in many villages, from shallow, un-

protected wells liable to pollution; but it is possible that contaminated food, and especially green vegetables, plays an important part in the dissemination of this disease. 3,326 deaths from dysentery were registered by the Registrar-General's Department during 1923.

Cancer and Sarcoma.—The number of patients admitted to the various hospitals during the year with malignant growths was 443, with fifty-nine deaths.

Ankylostomiasis.—114,157 cases were treated at dispensaries during the year. These figures refer to cases of ankylostomiasis as the primary disease; but owing to the almost universal infection of all hospital and dispensary patients, mass treatment for this disease was carried out during the year at dispensaries and the out-patient departments of hospitals and a large number of persons received necessary treatment.

Tubercular Disease of the Lungs (Pulmonary Phthisis).—The number of hospital cases treated during the year was 4,099 with 990 deaths.

Three special institutions—The Anti-Tuberculosis Institute, Colombo, the Kandana Sanatorium for early cases, and the Ragama Tuberculosis Hospital for advanced and chronic cases—are maintained to deal with this disease. A large number are yearly admitted to the tuberculosis wards of the General Hospital, Colombo, for want of sufficient accommodation at Ragama.

Leprosy.—Two asylums are maintained in the island for the segregation of lepers under the Lepers Ordinance—at Hendala in the Western Province and Mantivu Island in the Eastern Province.

The lepers are nursed by religious sisters with the help of male and female attendants at both asylums.

There were 116 lepers at Mantivu Island on December 31, 1922. Fifty-eight were admitted during the year under review (and of these, only twelve were new cases), thirteen died and forty-seven were discharged or absconded. 114 remained on December 31, 1923.

The medical superintendent reports seventy-nine lepers were treated during the year with E.C.C.O., the recently-discovered treatment for leprosy, and that the results have not been as discouraging as in past. In tubercular cases, if taken in hand early, and if the patients are of a robust constitution, there is a marked diminution in the size of the nodules and rapid softening of the skin. The best results are in the anæsthetic cases—sensation and colour of affected areas rapidly return. In all cases there is improvement in general health.

A female patient was discharged on parole, as she was apparently cured, and is being kept under observation. Four cases have shown such marked improvement under the treatment that it is hoped to be possible to discharge them as cured at an early date. It is expected that these results will encourage patients in the first stage of leprosy to seek treatment.

About four-fifths of the lepers in the asylum are in the last stage of the disease and of the advanced crippled nerve type, and these can only hope for some improvement in their general health from the new treatment.

Parangi (Frambœsia, or Yaws).—The number of hospital admissions was 9,748, with thirty-two deaths. The decrease in the number of hospital cases during the year was due to intensive campaigns by three itinerating medical officers and the treatment by modern methods weekly of a large number of out-patients brought by headmen to, and voluntary seeking treatment at, dispensaries and the out-patient departments of hospitals.

Plague.—There were 232 cases in 1923 with 211 deaths. Of the 232 cases reported during the year, eighty-four males and thirteen females were admitted to the Infectious Diseases Hospital, Colombo; and of the total treated during the year, 15·68 per cent. recovered.

Port Health Precautions.—During the year 2,363 British and foreign steamers and 285 native sailing vessels called at the Port of Colombo and were inspected.

Intravenous Protein Therapy in Septic Polyarthritis by Dr. E. C. Spaar, Physician, General Hospital, Colombo.—Female, aged fifty, admitted September 20, 1923, with swelling of shoulder, elbow, wrists, knee and ankle joints of three years duration. She stated that the trouble started with swelling of both knee joints unaccompanied by fever. Four days later the shoulder joints were involved and gradually the swelling spread to the other joints. On examination, the mouth was found very septic with marked pyorrhœa and was undoubtedly the source of the infection. The thoracic and abdominal organs appeared healthy. The pyorrhœa was treated by touching the edges of the gums with a weak solution of tincture of iodine and later of hydrogen pyroxide, which was also used as a mouth wash, and one injection of fifty million coli organisms was given intravenously in 10 c.c. of normal saline with due precautions on October 4, 1923, in accordance with the technique of Auld and Gow in England and of Pederson in America based on the researches of Nolf, all of whom have done so much to explain and perfect this new method of therapy. No untoward results followed, with the exception of severe pain in the elbow joints, which was complained of on the following day. Unfortunately, the patient refused to remain in hospital for further treatment, but on her discharge on October 8 there was no swelling in the lower extremities, and although the elbow joints were still swollen she was able to flex them and they seemed more supple. There would seem to be a promising future for this method of treatment in suitable cases.

Investigations on the Control of Hookworm Disease—Larval Activities by Dr. L. Fabian Hirst, Municipal Bacteriologist, Colombo.—The movements and general activities of the mature infective hookworm larvæ are very characteristic and remarkable.

Placed in water in a shallow cell the active larvæ exhibit frequent lashing movements, eventually finding their way to the margins of the cell, where they remain head outwards in a continual state of agitation.

Movement increases with rise of temperature to blood heat. At lower temperatures movements may not be continuous, larvæ sometimes passing into a resting stage, during which there is practically no expenditure of energy.

Larvæ in soil are found in the moisture film covering the soil particles. Their action is exerted between the resistance of the particle and the surface tension of the moisture film. After travelling some distance through soil larvæ became noticeably more transparent, due to loss of their food granules, which, when numerous, render them opaque. The smaller the size of the soil particles the greater the surface tension of their moisture film, the greater the resistance to larval movement and the more rapid the exhaustion of the larval store of energy, which cannot be replenished from without.

Observations made in the laboratory indicate that in a soil such as cabook, permeable to water, but resistent to larval motion, larvæ will remain more or less stationary for long periods if water is regularly added.

Till recently the idea prevailed that hookworm larvæ had great powers of lateral diffusion from an infected focus. This is certainly not the case. The slight lateral migration detected in Colombo soil was easily accounted for by the mechanical action of the currents set up after addition of water to the soil. Observations in the West Indies lead to a similar conclusion. If the moisture content of the zone surrounding the infected fæces be artificially increased on a horizontal plane lateral migration will take place, but such conditions can seldom occur in the field.

Till recently many sanitarians considered that hookworm fæces could safely be buried under a shallow layer of earth without risk of the larvæ developing and ascending to the surface. Recent research shows that burial affords no such security, unless the soil is restrictive of larval movement.

Hookworm larvæ moves upwards or downwards, according to the amount of moisture present in the different levels of the ground; if the ground surface is drying they descend to moister levels; if the upper layers of the soil are moist they ascend till they reach the surface.

The extent of the vertical movements of hookworm larvæ appears to be governed principally by three factors: (*i*) the size of soil particles; (*ii*) the distribution of the ground water; (*iii*) the amount of energy stored up as food granules in the body of the larvæ.

Mature larvæ are usually provided with a sheath which protects them to some extent from adverse influences. After moving even a short distance through compact cabook the sheath is lost.

Loss of sheath is much less marked after passing through a light sandy soil of the Narahenpitiya type. Only twenty per cent. of the larvæ added to cabook can be recovered by Baermann's method, whereas more than eighty per cent. can be isolated from Narahenpitiya soil. Preliminary experiments were made in January and February, 1923, on the vertical powers of ascent of hookworm larvæ. Stools heavily infected with hookworm larvæ and the filariform larvæ of *Strongyloides stercoralis*, after mixing with earth, were buried at the bottom of pits dug in hard cabook near the laboratory to the depths of six, twelve, eighteen and thirty-six inches.

The shallower pits were filled with coarse river sand, Narahenpitiya soil, and loose cabook. Both species of larvæ ascended six inches through all three soils, and hookworm larvæ twelve inches through each soil and through eighteen and thirty inches of sand.

It was proposed to repeat these experiments with definite quantities of larvæ, but in the meantime Florence Payne in America has published a report of such experiments in which numerous larvæ were recovered after an ascent of thirty-six inches through sand. She found in her experiments that the larvæ were unable to penetrate white clay, but ascended ten inches through a red clay.

The behaviour of hookworm larvæ in the surface of soil is of particular interest. Van Durme in 1902 drew attention to the remarkable attitude taken up by the filariform larvæ of *Strongyloides stercoralis* on the surface of particles of soil. Subsequently it was found by other observers that both human and canine larvæ behave in a similar manner. Larvæ attach themselves by one end to a particle of soil, preferably of fibrous nature, and extend themselves into the air. According to the writer's observations the motion of hookworm larvæ in this position is a slow to and fro way movement as if continually reaching for a new support. The *Strongyloides* larvæ exhibit a rapid jerky motion. Florence Payne reports that larvæ do not expend much energy in maintaining this position judging by the rate of disappearance of their food granules.

The larvæ may be observed to move from particle to particle on the surface by a species of looping motion. The aerial position is kept up for periods varying from a few minutes to half an hour or so at a time. Larvæ commonly cling together in aerial clusters which are readily visible to the naked eye on the surface of the soil. The surface of cultures of canine hookworm ova may be covered with waving plumes of larvæ.

The significance of this phenomenon seems clear. Perched in a favourable position on the surface of the soil the larvæ await their opportunity to come in contact with the human skin. So far as is known to the writer, only infected nematode larvæ of the penetrative type behave in this manner. The free-living soil nematodes, though often very active in their movements, remain in the interstices of the soil.

Colonial Medical Reports.—No. 173.—Ceylon (*contd.*)

Immediately contact is made with the skin a new set of forces come into play leading to the penetration of the epidermis, the passage of the larvæ to the lungs, thence to the bronchi, trachea and œsophagus. Full development takes place in the intestines, if the host is adapted to the species of the worm. *Necator americanus*, the Ceylon species of hookworm, has only two hosts, man and the gorilla. The series of forces which brings the larvæ on to the surface of ground moistened by rain, thence to the summit of the soil particles, or as high up as leaves and twigs as the moisture film extends, thence into the skin are analogous to the forces causing a plant to bend towards the light, or which drive a spermatozoa to its destination, the unfertilized ovum.

Pintner named the force thigmotropism which causes the larvæ to penetrate small pores. Brumpt has called the force driving larvæ into tissues histotropism. Khalil has recently described, under the name of thermotropism, the tendency of hookworm larvæ to move towards a heated point. The tendency of these larvæ to extend themselves into the atmosphere may be called ærotropism. It is sometimes difficult to separate hookworm larvæ present in soil from the free-living forms having a somewhat similar appearance.

If a great variety of larvæ are recovered from a mass of soil the task of scrutinizing them all under the microscope in order to make an accurate count of the hookworm larvæ is often excessively laborious.

Progress in hookworm research work has been mainly a question of development in technique. It was Baermann's discovery in 1917 of a convenient and reasonably quantitative method for isolating nematode larvæ from soil which gave the impetus to modern research into the epidemiology of hookworm disease.

The writer has sought to facilitate the task of separating hookworm larvæ from free-living forms by taking advantage of the tropic reactions described above. It was found that hookworm larvæ will penetrate porous membranes, such as filter paper, chamois leather, or buckskin with great ease. Non-porous leathers, parchment, rubber and similar substances are not penetrated. Larvæ penetrate into a membrane made of freshly dissected skin, but seldom pass through it.

The next step is to bring a membrane retaining a suitable fluid at blood temperature in an inverted tube or vessel lightly into contact with the surface of soil containing larvæ. The aerially extended larvæ then pass upwards through the membrane into the fluid where they may be readily recovered free from soil particles and almost free from non-infective larvæ. The results are somewhat affected by the temperature of the atmosphere. It may be necessary to cool the underside of the receptacle containing the soil. A buckskin membrane was commonly used in these experiments.

A curious phenomenon was noted during these investigations (September, 1922, to January, 1923). If a pan of soil showing numerous aerially extended larvæ be placed in the incubator at 37°C all the larvæ disappear from the surface of the soil. They re-appear in a few minutes at room temperature on the laboratory bench.

The technique can be adopted to any quantity of soil. A second test found of value is that of applying the suspected larvæ to the skin of a rat. If the suspected larvæ are able to reach the lung of the rat within three days with production of hæmorrhagic congestion of the organ, the result of the test is considered to be positive. Both canine and human hookworm larvæ give positive results to this test, provided sufficient numbers of larvæ are applied to the skin. Penetrative nematode larvæ of other species would doubtless give similar results. Free-living larvæ give negative results. Tests of this kind cannot entirely replace the crucial experiment of applying the larvæ to the human skin and expelling any hookworms developed, but enable such troublesome experiments to be reduced to a minimum.

The Value of Insulin in Diabetes Mellitus —A Brief Survey of Seven Cases by Dr. Lionel de Silva, Physician, General Hospital, Colombo.— The undue optimism and pessimism with regard to the value of insulin in the treatment of diabetes mellitus in Ceylon is, I think, a sufficient reason for this preliminary note.

A previous experience of a fair number of insulin cases in private practice provided me with the necessary impetus to attempt this treatment in seven cases which were in my wards more or less at the same time.

These remarks are based on the progress of these cases. Diabetes mellitus is not regarded as a definite disease to-day, for it is only a name given to an easily recognized group of symptoms of complex ætiology.

All these patients complained of these common symptoms, viz., polyuria (excess of urine), polydipsia (excessive thirst), polyphagia (excessive appetite), and some progressive wasting of varying degree. This well known group of symptoms, which is aptly regarded by some observers as a definite "syndrome," is due to the excess of sugar in the blood.

Experience of numerous blood-sugar determinations, both in England and in Ceylon, have led to the following conclusions, which will naturally be subject to modification with further knowledge and experience.

That although the physiological variations in the blood sugar, based on the experience of the West, range from ·08 mgm. to ·2 mgm per cent. there is marked difference to be noted in the cases observed in the inhabitants of Ceylon. This difference seems to be based on a racial factor, which bears an important relation to the mode of living and the susceptibility of the nervous system of the various races.

Blood-sugar determinations were made side by side with the urinary-sugar determinations in the private cases referred to. Opinion is unanimous regarding the fact that a single estimation of the percentage of sugar in the blood is very nearly

useless. It is the behaviour of the blood-sugar curve which determines the severity of the failure of carbohydrate metabolism and the dose of insulin given.

The method adopted necessitated a small quantity of blood sufficient to soak a piece of blotting paper half an inch square. The test was conducted in the following order.

First, as soon as the patient comes in after his customary meal taken two hours before the examination, a sample of blood is taken. This determines his normal percentage of sugar. The second sample is taken thirty minutes after the ingestion of 50 grm. of glucose. The third sample sixty minutes after, the fourth ninety minutes after, the fifth 120 minutes after. Five separate samples of urine were taken at the intervals above-mentioned, and the sugar was estimated by Benedict's method.

There was a marked similarity in the behaviour of the blood curve and the urinary-sugar curve in over seventy-five per cent. of the cases investigated.

This simple urinary test has so far been sufficiently accurate to justify its routine use and to supplement the more elaborate blood test, which, however, must be performed once at least in order to eliminate the possibility of the condition known as renal diabetes, &c. This urinary test has been termed by me the "urine tolerance test" for diabetes.

This was the test used in my ward cases in the manner already indicated before commencing insulin treatment. All the seven cases showed a severe type of the disease and gave the typical diabetic urinary-sugar curves similar to those that were given in my previous cases, where combined estimates were done. The first step in my treatment was to withhold the administration of insulin and drugs altogether, the patient being restricted solely to the dietetic treatment. Daily examinations of urine for the next few days showed a diminution on the average of about twenty per cent. of the quantity of sugar originally passed. The value of the carbohydrate diet was considerably under 50 grm. per diem. There was noticed a slight improvement in the symptoms. The urinary-sugar output and the general condition remained unchanged at a constant level for the next few days. This clearly indicated that this treatment has had its maximum effect, and that something more had to be done in the way of treatment.

The second step in the treatment was now begun by the exhibition of drugs, while still continuing unchanged the previous line of dietetic treatment. Drugs were given to stimulate the liver functions and to relieve freely the constipation which is so frequently present in these cases. The result of this combined method brought about a well-marked improvement, but the symptoms of glycosuria persisted to such a degree as to warrant further treatment.

Two of these cases suffered from some surgical complaint which needed operation, and two others had the grave complication of pulmonary tuberculosis which rendered the rapid reduction of the hyperglycæmia imperative.

Then I reached the indication for the third stage of the treatment. It is here that we realize the great boon that has been conferred upon the diabetic by Banting and his co-workers. The urine tolerance test was again done before the insulin was administered, and it was noticed that the tolerance curve was still that of a severe diabetic. Although there was noticed slight improvement in the curve at this stage of the treatment, all the cases justified the use of insulin in 10 unit doses twice a day. The sugar in the urine was estimated twice a day, morning and evening.

The diet and medicines were continued in some cases, and in the others a more liberal diet was given, and the medicines withheld. In the cases where the combinaton of insulin, diet, and drugs were administered at the same time the improvement of the patients was remarkably rapid. The sugar in the urine disappeared entirely in one case by the fifth day and within ten days in the other cases. An emaciated boy of eighteen, for example, gained nearly 20 lb. in weight within two months by this combined method of treatment.

In the cases above referred to the administration of insulin was reduced to once a day only at the end of a fortnight. The diet was gradually increased, according to the individual requirements, and the drugs were gradually reduced till the patients passed a sugar-free urine on a diet of the approximate value of 150 grm. of carbohydrate. When the insulin was finally withheld altogether there was a re-appearance of a little sugar in two or three of the cases. This, however, was readily adjusted by slightly diminishing the carbohydrate intake. As long as patients keep to a reasonable diet and take sufficient care of themselves there is no doubt that they can pursue their ordinary vocation like other people who are free from the disease. Such people can answer to those that desire to know—does insulin cure diabetes? Yes, it does cure the careful man.

The disease persisted for a longer time in the cases that were treated with insulin alone until the combined method was adopted, when equally satisfactory results were obtained.

After some time there were a few recurrences, and on investigation it was found that these patients had, by various means, taken three or four times more carbohydrate than their recently gained capacity permitted.

Diabetics have such a craving for carbohydrate foods that they seem unable to resist the temptation. These form the majority of the people who swell the ranks of the pessimists who fail to see the benefits of this valuable preparation. Optimists and opportunists do or do not want to see that at least fifty per cent. of the cases in Ceylon are amenable to ordinary treatment without insulin. This fact, however, does not minimize the value of one of the most important discoveries of this century.

Colonial Medical Reports.—No. 174.—Bihar and Orissa.

ANNUAL PUBLIC HEALTH REPORT OF THE PROVINCE OF BIHAR AND ORISSA FOR THE YEAR 1923.

Periodicity in Disease.

There is undoubtedly a periodic function of epidemic and infectious diseases, but it is difficult to define and is masked by many other influences which affect the prevalence of such diseases. It may be noted that some diseases, such as plague and small-pox, are more regular in their recurrence, whereas malaria and cholera, which depend more upon favourable climatic conditions for their epidemic spread, are more irregular. It appears, however, certain that each violent epidemic is followed by a corresponding reaction in which the disease is much less prevalent than ordinarily, and that if local and other influences could be eliminated, or allowed for, it would probably be possible to define accurately the periodicity of each disease. Each epidemic disease appears to have a different cycle of recurrence, the periodicity of which is based upon the immunity created in the population by the epidemic prevalence of the disease itself. In short it appears that the problem is fundamentally one of immunity, and that the periodicity of epidemic diseases depends upon the degree and the duration of the immunity which results from the general prevalence of the disease.

Epidemicity.

Epidemicity is, from the public health point of view, the most important and most characteristic property of many infectious diseases. We know that certain diseases can become widespread and severely epidemic with great rapidity. We know a good deal about the diseases themselves, but we know very little about the conditions which make them suddenly and severely epidemic and which often with equal suddenness cause the epidemic to subside.

Each disease has an epidemicity of its own, which may be defined in mathematical terms as a function of the disease itself, which is probably constant. This epidemicity factor in some cases is very small, e.g., in leprosy, whilst in diseases such as cholera it is very large. The rapidity of the spread of a disease in epidemic form varies directly with the epidemicity factor, but is, of course, also affected by other factors. When the epidemicity factor is large, as in cholera, the logical conclusion would be that the entire population would be stricken, but what we actually find is that "one is taken and another is left." The disease spreads rapidly, but fails to affect a large number of the population. That failure is not due to human intelligence nor human effort, which are minor factors in the bulk of the population. It is also not purely nor even largely accidental, which is obvious on mathematical grounds. The phenomenon is too regular and certain in its occurrence to be due to any other than a direct cause. Hitherto the observed facts have been known but not understood. The recent work of d'Herelle has made clear the cause and has definitely linked up the periodicity and epidemicity of disease with immunity, by showing how nature has made and controls the balance between the human organism and infectious diseases, and how the "bacillus" is held in check and prevented from multiplying indefinitely, and at the expense of the human population.

Comparative Incidence of Chief Diseases.

The death-rate for the year was less than the average of the last ten years, and there was a marked reduction in the incidence of all epidemic diseases, especially fevers and cholera.

The infectious diseases, the spread of which largely depends upon overcrowding, density of population, and the consequent facilities for infection, are consistently more prevalent in the towns, whereas fevers, of which malaria is the chief, are more prevalent in the rural areas, where the facilities are greater for the breeding of anopheline mosquitoes and where the economic condition of the people is frequently not so good.

The large towns are hot beds of consumption, and this disease, together with pneumonia and influenza, causes the death-rate from respiratory diseases to be many times greater in towns than in rural areas. Similarly, cholera and plague are more prevalent in the towns than in the villages.

Cholera Preventive Measures.

Special preventive measures were taken, and a special staff was employed as usual. The use of chlorinated lime for disinfecting wells has now been generally adopted by local bodies and the procedure is generally known and appreciated.

A special epidemic cadre of ten assistant surgeons was maintained. The headquarters of the cadre were at Patna, and these officers were sent out on epidemic duty throughout the province whenever epidemic disease was prevalent. They were employed on plague duty in Bihar, and cholera duty at Puri and in Orissa and Bihar, and at other times they were employed in carrying out some investigation work.

A special epidemic reserve of one hundred vaccinators was also maintained from April 1 to the

end of September for cholera and other epidemic duty.

These men received a few days training in the use of disinfectants and in the disinfection of wells, and were sent out by the civil surgeons with disinfectants and a few simple remedies whenever cholera was reported.

During the year, a new scheme for a simple and cheap organization for preventive measures against cholera and other epidemic diseases was issued to all local bodies and it is proposed that this scheme should be taken up as far as funds permit.

At the same time, a leaflet on "Simple Instructions for the Prevention of Epidemic Diseases" was issued to all local bodies, the Press and many Government Departments, and many District Boards and Municipalities have reprinted this leaflet in vernacular and distributed it broadcast through schools, sirpunches and other local agencies.

Cholera is a preventible disease and the only source of infection is human excreta. The cholera germ does not live long outside the human body, and if it can be killed by disinfection as soon as it appears upon the scene, we can largely prevent the spread of the disease.

As it is, the transmission must be rapid from the excreta of one case to the body of the next, and that this is so is illustrated by the rapidity with which epidemic cholera sweeps through a town or district. It is, therefore of primary importance to deal with the source of infection promptly and thoroughly in order to prevent the spread of the disease. This means that disinfection of the excreta and of all contaminated things must be done without delay. If this is done, the disease cannot readily spread, because there is very little chance for the infection to get into water, wells or food, or on to flies, or people's hands. The time factor here is the all-important consideration. Every second's delay means risk, and much delay means failure.

The epidemic prevalence of cholera is largely associated with the prevalence of flies, and good conservancy and the rapid removal and disposal of excreta are fully as important measures for the prevention of cholera as the provision of pure water supplies, and both these preventive measures should be widely adopted, especially in towns, if cholera is to be kept in check and ultimately stopped.

Small-pox.

The death-rate fell in seven out of twenty-one districts. It is well-known that vaccination is the best and the only real means of prevention of small-pox, and yet vaccination is neither compulsory nor free. There is no doubt but that the cost of vaccination work is a splendid and profitable investment of public funds, which can save many lives and much sickness and suffering. It would, therefore, appear to be wise and proper to organize the work more effectively and to make vaccination compulsory and free, in order to get the whole population protected and thus abolish a disease which is of all diseases the most easily and cheaply preventible.

The manufacture of vaccine lymph and the organization and staff for vaccination work are all at present arranged for by Government, and facilities are available throughout the province for getting the operation performed by trained vaccinators with pure vaccine.

Fever Statistics.

There was a fall in the rate of mortality under this head in five districts. The highest mortalities were recorded in the districts of Purnea and Palamau, and amongst towns in Kendrapara, Gaya, Jagadispur and Purnea.

Mortality from fevers is an "omnibus" return which includes a large number of pneumonia cases, kala-azar, phthisis, typhoid and, in short, all diseases of which fever is a symptom. In my experience malaria is not an ordinary cause of much mortality in most of the districts of Bihar, and I agree with the opinion recently expressed by the Public Health Department of the United Provinces that malaria is only responsible for a small proportion of the deaths from fevers. The recent investigation into the details of vital statistics in a selected area in Bengal also supports this view, and I think it may be stated as more than my personal opinion that, with the exceptions of particular areas and of epidemic invasions, malaria is not an important cause of mortality in the province of Bihar and Orissa, and that therefore the occurrences of epidemic malaria or influenza may be accurately estimated by any abnormal increase in the reported mortality from fevers.

Malaria in Bihar and Orissa.

The economic importance of malaria as a cause of debility, ill-health and ultimate mortality throughout the province is, however, great. The disease is endemic throughout the province, though to a varying degree in different districts, and it tends to become often epidemic in localized areas where the conditions are favourable to its transmission, and to become generally epidemic over larger areas at intervals. The year under report was a phenomenally healthy year owing to the prosperity and favourable climatic conditions which prevailed, but the disease was prevalent in epidemic form in Balasore and Cuttack districts and began to spread into the district of Puri. Similarly it was very prevalent in several parts of Chota Nagpur, especially in Singhbhum and parts of Ranchi district.

In my opinion it is not practicable to prevent malaria, or to reduce it permanently or on any large scale, by the use of quinine. The quantity of quinine required does not exist, and if it *did* the people would not swallow it. Quinine is essentially a drug for the treatment of malaria as a disease, but it is not a means of stamping out the disease, nor of preventing it on a large scale under existing conditions.

Colonial Medical Reports.—No. 174.—Bihar and Orissa (*continued.*)

The adoption of non-productive and anti-malarial operations such as draining, levelling, filling hollows and oiling water surfaces is also not a feasible means of prevention on a large scale over an enormous area. The staff which would be required to carry out such works and to maintain them would be enormous, and the expense would be colossal and prohibitive. It is, therefore, in my opinion, a waste of time to discuss and to advocate the use of such measures, except in special cases.

What is wanted is a policy of malarial prevention which will pay its own way and can be carried out in conjunction with other work of a productive nature. The people might then be expected to take up such work individually in their own interest, and the collective result of work carried out by countless workers throughout the province would be definite and more permanent. Further, such a policy would at the same time improve the economic condition and the prosperity of the people and would indirectly also reduce the prevalence of all epidemic diseases by making the people healthier and stronger.

Such a policy is possible: it is already being carried out in Italy and Spain with extraordinary success. It consists in combining agricultural improvement with sanitation, by draining or flooding marshes and wet lands in a scientific manner so as to produce larger crops, and at the same time to reduce the breeding of transmitting mosquitoes and the spread of malaria. It also includes the cultivation of waste lands as far as possible and the intensive cultivation of good lands.

Sir Edward Buck, K.C.S.I., wrote a most interesting report on this subject in 1907, and recently the question was again raised by Mr. Inglis, who sent to the local Government a number of extracts from recent Italian literature.

This policy is possible and it is productive. It improves the health and the prosperity of the people at the same time, and the more their health is improved the more land can be brought under cultivation and so the results are cumulative and progressive.

Sale of Quinine.

The sale of quinine treatments during 1923 amounted to a total of 1,027·6 pounds of quinine sulphate as compared with 639·1 pounds in the previous year. The increase is due to increase in the prevalence of fevers in some of the Orissa districts and also to the increased prosperity of the people, which has created a much large purchasing capacity. Quinine was chiefly sold through the agency of postmasters, and to a slight extent through other agencies. Owing to the increase in the wholesale price of quinine during the last few years, it is now under consideration to supply cinchona febrifuge instead of quinine for retail sale throughout the province, as this drug is quite effective in treatment and can be sold at half the price of quinine.

Plague Statistics.

The provincial death-rate from plague was ·8 as compared with ·4 in the previous year. More or less regular recrudescences of plague occur at periodic intervals of about four years. The disease has not shown any marked tendency to spread outside the epidemic area, and it appears to be slowly diminishing in virulence and in prevalence with the lapse of time. The recrudescence of plague which occurred during 1922-23, five years after the previous periodic increase was followed, as was anticipated, by a further diminution in the incidence of plague during the cold weather of 1923-24.

Dysentery and Diarrhœa.

The death-rate from dysentery and diarrhœa was ·5 as compared with ·5 in the previous year. As usual, this disease was most prevalent in the Orissa Division and of the total deaths, amounting to 18,788, this division reported 14,249.

These diseases resemble cholera in their nature and in their incidence. They belong to the group of intestinal diseases, the transmission of which is associated with the infection of the individual by be effected by the improvement of water supplies, by excreta, or of food by flies. They tend to become epidemic under the same conditions and by the same means which favour the spread of cholera and their prevention, like that of cholera, can best be effected by the improvement of water supplies by better conservancy and by prompt disinfection of the excreta of the sick. The effects of introducing piped water supplies in the towns of Gaya and Bhagalpur were that the death-rates from cholera, dysentery and diarrhœa were immediately reduced to about half of what they had been in previous years, and they have since remained at the lower level. This means an average saving of 700 lives from these diseases, chiefly the lives of children, in these two towns alone, every year.

Hookworm.

The prevalence of hookworm infection, and the importance of the disease, both as a predisposing factor in the prevalence of other diseases, especially intestinal diseases and malaria, and as an economic factor of great importance in the productive capacity and prosperity of the population have attracted considerable attention in recent years. Investigation work has been carried out in other provinces as well as in Bihar and Orissa.

In Bengal, a special staff was employed for two or three years and it has been shown that approximately two-thirds of the population of Bengal are infected with hookworm. In the United Provinces the prevalence of the disease varies in the different parts of the province, but is greatest in the Gangetic districts adjoining this province in which over 80 per cent. persons examined were found to be infected. In this province investigation has been

carried out which has shown the general prevalence of the infection, varying from fifty per cent. upwards to over 75 per cent. of the persons examined

There is, therefore, no doubt about the existence of the disease, and the slight variations in its prevalence are immaterial. The importance of the disease, both from the health and the economic points of view, is best demonstrated by the experience of the results of anti-hookworm campaign work in tea gardens and in America. The results are immediate and definite. There is a marked improvement in the health and in the working capacity of the population which it is difficult to appreciate until it is seen, but which, when seen, at once convinces the observer, as it has already convinced the population which has been treated.

The disease is easily and rapidly curable within a few days, in the majority of cases, and the patient who was previously unaware of illness, but who suffered from enfeebled health and diminished vitality and vigour, immediately begins to feel better, stronger and more vigorous. The prevention of this disease entails both the treatment of infected persons and an alteration in the habits of the people, requiring them to abandon the general practice of relieving themselves in the fields, and to take to the use of latrines in order to prevent the continuous and rapid re-infection of the population from the soil.

The curing of infected persons and the prevention of the disease by removing the means of infection, as above indicated, can both be accomplished in time, but not immediately. The cost of such measures on a large scale would be enormous and can only be met, as in the case of preventive measures against other diseases, by an improvement in the economic condition of the people. With regard to this disease also, we are again faced with the general proposition that the prevention of disease is very largely an economic question, and that unless it is considered and attacked from that point of view, little or nothing can be done to deal with it.

The latest work on this disease indicates that heavy infection is necessary to give rise to special symptoms and that local conditions of overcrowding and general filth, such as contained in construction works, mines, &c., where coolies are temporarily collected in large numbers, give rise to a heavy infection of the soil and a corresponding subsequent heavy infection of the population. The number of eggs passed by one infected person is enormous, and the cumulative effect of repeated infections produces marked debility and anæmia. Beta-naphthol, thymol, and carbon tetrachloride appear to be the most reliable drugs for treatment, but it must never be overlooked that treatment alone is largely a waste of time. The use of latrines and general cleanliness, and in cases where a heavy soil infection exists the disinfection of the surface soil in and adjacent to the houses is necessary if the disease is to be dealt with effectively.

Colonial Medical Reports.—No. 175.—Colombo.

REPORT OF THE MEDICAL OFFICER OF HEALTH FOR COLOMBO FOR THE YEAR 1923.

THE health of the city as gauged by the amount of sickness and the mortality was not satisfactory. The crude death-rate was 35·5. At the time the census was taken Colombo had not fully recovered from the effects of the war and a great part of the large immigrant population, which had left the town during the war, had not returned, so that the population figure obtained at the census was considerably below the true figure.

Conditions have now changed, trade is flourishing, prosperity is returning, and with it those who left the town and also fresh immigrants in search of employment, so that the population of 300,924 obtained on the basis of the estimates prior to 1921 may be taken as nearer the mark than 250,433 obtained on the basis of the census population of 1921. The death-rate calculated on this population, i.e., 300,924, is 29·6 per thousand and 25·9 per thousand, exclusive of the deaths of non-residents.

The unusual weather conditions that prevailed last year were, no doubt, mainly responsible for the increase of the death-rate over the previous year, but, apart from this, the average death-rate from phthisis, pneumonia, enteric fever, and infant mortality, is still very high. The principal causes which maintain these death-rates at a high level are bad housing conditions under which the poorer classes live, the bucket-latrine system, bad drainage, and poverty.

Of all the problems the municipality is faced with the one dealing with the housing of the working-classes is the most important and urgent. The great wastage of human life, not to speak of the suffering and loss of efficiency occasioned by disease, that takes place every year imperatively demands the earliest attention to this problem. No satisfactory reduction in the general death-rate could be expected so long as a considerable proportion of the population lives under conditions most favourable to the generation and spread of disease and most inimical to health and life. There are other problems, too, awaiting solution, such as infant mortality, malaria, adulteration of food,

drainage, &c., but in order of importance the question of housing comes first.

Anti-Mosquito Work.

Weather conditions last year were most favourable for the breeding of mosquitoes, and consequently a very large number of complaints was received from all parts of the town. Queen's House was also badly invaded, and on investigation many of the gutters of the buildings in its vicinity were found to be breeding mosquitoes. The species found were chiefly stegomyia and culex, with a few migratory species. No malaria-carrying mosquitoes were found. In the great majority of cases, blocked or badly-sloped gutters were found to be the chief breeding places.

In addition to attending to complaints, the staff was engaged in its routine of house-to-house inspection in the residential area.

The number of complaints received by this department has been steadily increasing. The public, with a few exceptions, take no interest in mosquito prevention and expect the Public Health Department to do everything for them. With the very small staff of one sub-inspector, six overseers and twelve coolies, it is impossible to inspect all the premises in the town, and to destroy the breeding places. What is needed is legislation making householders and owners of property responsible for preventing the breeding of mosquitoes on their premises.

Births.

There were 7,107 births registered during the year. The rate is higher than that of 1922, but lower than those of 1920 and 1921, when the unusually high birth-rates, as pointed out in previous reports, were recorded.

Deaths.

There were 8,893 deaths registered during the year. It is rather disquieting to record that the crude death-rate for the year was higher than that of any other year of the decennium, but as explained under the section dealing with population, the rate cannot be relied upon as it was calculated on a population much lower than the actual, and if it had been calculated on the estimates prior to the taking of the census, the rate would have been reduced to 29·6, a quite satisfactory one.

Pneumonia is still the prime contributory cause of the general death-rate, due to a great extent to the prevalence of influenza.

Infant Mortality.

Total deaths, 1,929.

The principal causes of death were convulsions, atrophy and debility, diarrhœa, premature birth and pneumonia.

Infectious Diseases.

Notifiable infectious diseases reported during the year were plague, cholera, small-pox, chicken-pox, continued fever, phthisis, scarlet fever, typhus fever, continued fever, phthisis, scarlet fever, typhus fever, totalling 4,836 cases.

Pulmonary Group of Diseases.

Under this heading are included pneumonia, phthisis and bronchitis, of which only phthisis is notifiable.

(*a*) *Pneumonia.*—Deaths, 1,251.

Pneumonia is one of the most fatal of all acute diseases; it claimed the highest number of deaths during 1923; 14 per cent. of all deaths in Colombo were due to this disease. It was prevalent throughout the year with a marked increase during the first five months, and again in the month of September. Pneumonia is an infectious disease which is spread from person to person through the secretions of the mouth and nose, and overcrowding naturally favours contact infection. Its excessive prevalence in Colombo is due to a large porportion of the inhabitants living in overcrowded, ill-ventilated, stuffy rooms, and to other predisposing causes, such as chills, exposure, dusty atmosphere, poor and insufficient food, alcohol, and anything that tends to lower the vitality. Influenza was again undoubtedly responsible for the increased mortality.

(*b*) *Phthisis.*—727 deaths. Naturally, the most crowded and insanitary areas of the town show the largest number of cases. Next to pneumonia, phthisis claims the highest number of deaths. In Ceylon the disease is mainly spread from man to man through direct association; infection through infected milk is practically unknown. It is a disease fostered by overcrowding, bad lighting and ventilation of living rooms, dust, &c., and nine-tenths of the tenement dwellers of Colombo live under these conditions. Improved housing conditions diminish the incidence of phthisis by reducing the chances of contact infection, providing more light, purer air and sunshine in houses, and generally raising the standard of cleanliness. Other measures are also necessary, such as early diagnosis and notification, segregation of sick, proper disinfection and disposal of sputum, medical inspection of workmen in factories, education of the public, the after-care of cured cases, &c. Many cases which have improved under treatment or been completely cured and discharged from hospital or sanatorium return to their wretched homes to get re-infected and die. The most important preventive measures therefore are: the improvement of the housing conditions, and the after-care of patients. With the steady increase of population, the housing problem becomes aggravated and more and more difficult to solve and the poor are hard put to it to find any kind of accommodation within a reasonable distance of their work places.

Dust is another important factor in the spread of phthisis: in the districts in which the poor live the streets are deep in dust, and it is not only a nuisance, but a serious menace to the health of the people.

(*c*) Bronchitis.—Deaths, 188.

Bronchitis shows a decrease compared with the previous year.

Influenza.

317 deaths were registered.

Judging from the number of cases treated at the Municipal Dispensaries, the disease was prevalent throughout the year, with a rather marked increase in the months of May and December. Influenza is highly infectious in the early stages, and as most people regard it at first as a common cold and go about their daily routine even during the febrile stage, the infection becomes widespread, especially as one attack of the disease seems to predispose to subsequent attacks. The control of the disease rests mainly with the public; if the first case in every household is properly isolated and the patient stays in bed without going about broadcasting the germs, the disease would not become so widely prevalent. Neglect or exposure to cold and wet during the febrile stage, or before the catarrhal symptoms have completely disappeared, is generally dangerous, and when pneumonia supervenes the disease usually ends fatally. Influenza was undoubtedly responsible for the increased mortality from pneumonia.

Diarrhœal Diseases.

Under this heading are included diarrhœa, enteritis, and dysentery, none of which are notifiable.

The total deaths from all these causes were 990, diarrhœa and enteritis 681 deaths, and dysentery 309 deaths.

These diseases are associated with flies, overcrowding, lack of cleanliness and other unhygienic conditions, all of which are usually present in the slum areas, and which were aggravated by the weather conditions of last year. Owing to the epidemic of rinderpest, dung could not be regularly removed from dairies and cattle sheds, and consequently flies, which play such an important part in the spread of enteric, dysentery, &c., by contaminating food, were exceptionally prevalent throughout the year. In addition, the refuse destructor was out of commission for some time, and all refuse was dumped within the town in the swampy land near the destructor, and this undoubtedly provided an excellent breeding place for flies. Also, the exceptionally wet weather led to increased overcrowding, accumulation of organic refuse, pollution of soil, neglect of private premises and bucket latrines—conditions favourable to the generation and spread of these diseases.

Fevers.

Under this heading are included enteric fever, continued fever of over seven days' duration, and remittent and intermittent fevers, of which only the first two are notifiable.

Enteric Fever.—741 cases; 269 deaths.

As usual, the crowded insanitary areas of Kotahena and Maradana Wards were chiefly affected. As stated in the section dealing with diarrhœal diseases, flies were exceptionally bad last year, and the general sanitary conditions of private premises and bucket latrines was, on the whole, unsatisfactory, and these conditions were undoubtedly responsible for the increased number of cases. Cases are notified often so late as to make preventive measures practically useless. See explanation for this under section dealing with continued fever.

Continued Fever.—Total cases, 110; deaths, 37.

The majority, if not all, of the fatal cases were probably cases of enteric fever which had been seen, perhaps only a few days before death by the medical practitioner reporting the case. All the fevers which are not definitely diagnosed are usually reported under the convenient term of continued fever, and the real nature of the disease remains unknown.

Malaria.—Deaths, 166.

Malaria was unusually prevalent throughout the island last year.

Early last year, in a house in Alston Place, six cases of locally-acquired malaria, microscopically confirmed, were brought to the notice of this department, and on investigation two chronic malarial subjects were found living in the adjoining house. On search being made for mosquito breeding places, *Anopheles sinensis* was found breeding in a pit in the adjoining premises, and in a pool in the reclaimed part of the Hunupitiya end of the lake. An adult *Anopheles listoni* was caught in the patient's bungalow, but its breeding place, though carefully searched for, was not discovered.

Another case of locally-acquired malaria was reported from Horton Place, and on investigation, *Anopheles sinensis* was found breeding in the swampy land at the junction of Horton Place and McCarthy Road. All these breeding places were abolished, and no further cases were reported from the Cinnamon Gardens district.

2,411 cases of malaria were treated at the four Municipal Dispensaries during the year. In the case of 1,932 of these, there was a definite history of infection acquired outside Colombo. As regards the rest, 432 cases were not traced, as false addresses had been given at the dispensaries, and in 43 the infection was believed to have been acquired in Colombo. These cases were not microscopically confirmed, and it is possible that all were not malaria and all were not infected in Colombo, as several of these cases, particularly the Modera and Rajamalwatta ones, had been on pilgrimage to shrines in malarial districts, and had probably acquired infection there. In the case of some, the evidence seems to be in favour of local infection. The majority of these cases occurred moreover in the neighbourhood of swampy grassfields where mosquitoes are always bad, and where *Anopheles rossi* was found in large numbers, but the part this species plays in transmitting malaria has not been fully worked out. In the districts in which these cases of malaria occurred, numbers of people harbouring the malaria parasite live. They are, for the most part, workmen who have returned to Colombo ill with malaria acquired in the various new railway extensions in the island

Colonial Medical Reports.—No. 175.—Colombo (*continued*).

These carriers are important factors in spreading the infection, and are a distinct danger to the town, because they increase the foci of infection within the town. Known malaria carriers such as *A culicifacies*, *A. listoni*, and *A. sinensis* have been found breeding within the town. We do not yet know definitely whether *A. rossi*, which is found in such large numbers in the town, is an effectual agent in the transmission of the disease, but if it proves to be so, Colombo, with its extensive swamps within and around it, and with no anti-mosquito legislation, will be faced with a very serious problem.

PLAGUE.

Human Plague.—There were 230 cases with 209 deaths.

The marked increase above the average which began in December, 1922, was maintained till the end of February, when there was a marked drop, the weekly incidence during the first three weeks of March and again the number of cases went up, and kept above the average, practically right through the off-season with a well-marked increase in August and September. An unusual feature was the comparatively large number of rat and human plague cases during the off-season.

Last year's abnormal rainfall, associated with a low atmospheric temperature and high humidity was undoubtedly responsible for the large number of cases of plague during the normal off-season. It is especially noteworthy that the proportion of *Xenopsylla cheopis*—the special plague-carrying flea found on rats—never fell below 9·49 per cent. Dr. Hirst is of opinion that the number of *X. cheopis* was abnormal throughout the off-season of plague, and the increase more pronounced than usual in November and December. He attributes this increase to the abnormal weather conditions which were favourable for the multiplication and survival of *X. cheopis*.

Of the 230 cases of plague, 66 were septicæmic and 164 were bubonic. As statement 40 shows, since 1920 the proportion of bubonic cases to septicæmic cases had been gradually increasing, and last year it was the highest. From 1914—the year of outbreak of plague in Colombo—to 1919, the proportion of septicæmic cases of plague was higher. Dr. Hirst thinks this is due to a gradual lowering of the virulence of the Colombo strain.

As usual, males between the ages of fifteen and twenty-five were chiefly attacked.

Rat Plague.—29,312 rats were examined at the Municipal Bacteriological Laboratory, and 153 were found to be infected. The vast majority of rats which become infected die in their underground runs, and the number of infected rats known represents only a microscopic minority of the number which die. There was an outbreak of rat plague at the Customs in the month of May, when 29 dead rats were found in a block of warehouses; 27 of these rats were found on bacteriological examination to be plague-infected; the other two were mummified and unfit for bacteriological examination, but had undoubtedly died of plague. Twenty-one live rats were killed, but they gave a negative result for plague.

One cat and one squirrel were found plague-infected during the year. The cat was found dead near a plague-infected house, and the squirrel was found in a house where there were several cases of rat plague.

Rat Destruction.—Altogether 137,645 rats were accounted for during the year, of which 133,684 were caught in traps, 642 were found dead (283 of these were in a mummified condition), and 3,319 were killed by the Clayton fumigators and their bodies recovered.

1,693,285 poison baits were placed, of which 80,296 were eaten or removed by rats. It is impossible to estimate the number of rats that are killed by these poison baits, or by the fumigators, as it is not possible to trace and open up all the innumerable rat-runs without seriously damaging the building and interfering with trade, but it is believed the number so killed is very large.

Preventive Measures.—The same preventive measures as hitherto were carried out during the year.

SMALL-POX.

There were thirty-two cases of small-pox and one death during 1923.

CHICKEN-POX.

There were 1,315 cases, including four from the Port, and seventy-six from outside town limits. There was one death, that of an infant fifteen days old, brought to the Infectious Diseases Hospital from an out-station.

The disease was most prevalent during the first five months of the year.

MEASLES.

Measles again assumed epidemic proportions after an interval of three years. The last epidemic was in 1920, when there were 1,062 town cases. During the year under review the highest number of cases was recorded during the month of March.

The total number of cases was 789. Of these, 471 cases were of children under ten years of age, 128 of children under fifteen years of age, and 190 persons over fifteen years of age. There were sixteen deaths, all of children under ten years of age.

DIPHTHERIA.

There were nineteen town cases and eight outside cases during the year with seven deaths. Of the twenty-seven cases, twenty-one were of children under twelve years of age, four of children under sixteen years of age, two only of adults.

MISCELLANEOUS DISEASES.

Leprosy.—Three cases of leprosy were reported by the Public Health Department to the Principal Civil Medical Officer during the year for action to be taken under the Lepers Ordinance, No. 4 of 1901. Two of these cases were of the anæsthetic

type, and the other one was of the tubercular type.

Tetanus.—Total, fifty-nine deaths; fifty-two adults and seven infants.

Syphilis.—83 deaths; twenty-four adults and fifty-nine infants.

There were no cases of cholera, scarlet fever, typhus fever or beriberi.

Investigations on the Control of Hookworm Disease.

Previous annual reports contain references to the remarkable outbreak of hookworm disease, which occurred in May, 1919, among a gang of coolies engaged in digging out a new set of trenches at the Northern Sewage Treatment Works.

The coolies developed dermatitis wherever their bodies came in contact with the soil of these trenches. Close inquiry was made into all the circumstances by Dr. Marshall Philip and the Ceylon Sanitary Commissioner, but no other source of infection could be traced than the septic tank sludge buried in the trenches at least two years previously. Numerous larvæ closely resembling, if not identical with, hookworm larvæ were found in the suspected soil.

At that time the tanks were unmodified. Sedimentation was very inefficient, the contents of the tanks being kept in a constant state of ebullition by the escape of large volumes of the gaseous products of the excessive fermentation which takes place in septic tanks at tropical temperature.

Hookworm ova and larvæ are carried through septic tanks in this condition in a few hours, and continually pass out with the effluent or with the uppermost layers of the sludge at each opening of the sludge valves. Owing to the danger thus disclosed the proposal to sell the sludge as a valuable manure had to be abandoned.

The question of the viability of hookworm ova and larvæ in soil also arose in connection with the safe disposal of the fifty-acre night-soil burial ground at Narahenpita.

For more than twenty years night-soil representing the fæces deposited by a population of some 200,000 people had been buried in these fields.

In 1922 the Water Carriage Sewerage Scheme was sufficiently completed to enable the depot to be closed so that the land became available for other purposes.

On August 17, 1922, another remarkable outbreak of hookworm dermatitis occurred amongst a gang of eight coolies engaged in clearing the sump of the Maligawatta Pumping Station.

It is hoped to report the full details in a medical journal, but a brief summary of the circumstances is given here.

In order to clear out the sump the nearly naked coolies immersed their bodies in the semi-liquid sludge, one at least up to his neck. Within half an hour all eight men were complaining of intense irritation of the skin, which increased to the extent of disabling them for duty on the following morning.

The writer saw these men on the evening of the second day and diagnosed the condition as hookworm dermatitis. The eruption was co-extensive with the area of each man's skin that had come in contact with the sludge. The sludge itself was found to contain typical hookworm larvæ in addition to numerous larvæ of other nematodes.

The coolies were handed over to Dr. J. F. Docherty, the Ceylon Director of the Ankylostomiasis Campaign. Most of the men were already lightly infected with hookworm. They were treated till free from ova with carbon tetrachloride and guarded as far as possible from reinfection. About eight weeks are usually required for the larvæ to reach the intestine from the skin, mature, and pass into the bowel. The coolies were examined for ova at intervals and finally on the ninety-first day the worms were expelled with a full dose of carbon tetrachloride, followed by salts. The species of worm was *Necator americanus*.

The worms expelled may be taken to represent 98 per cent. of those actually present. The number of worms recovered was perhaps less than might be expected from the degree of dermatitis. It is an interesting speculation to what extent the penetrative larvæ of domestic animals may have been responsible for some of the dermatitis.

According to Brumpt many such larvæ are capable of penetrating the human skin and setting up inflammation, though unable to establish themselves in the human intestine.

The results are evidence of a new danger to the health of the labour force engaged in a tropical sewage works. Several other isolated examples of hookworm dermatitis among coolies engaged in clearing sumps or septic tanks have subsequently occurred.

It clearly became necessary to inquire into the following:

(1) How many hookworm eggs were contained in an average mass of fæces passed into the sewers or deposited in the trenches at Narahenpita.

(2) What proportion of these eggs could be hatched out in sewage or beneath the soil.

(3) How far can the infected larvæ ascend to reach the surface through typical soils.

(4) How long can these larvæ survive in these soils or sewage under the most favourable conditions likely to be met with in Colombo.

Some preliminary work on these problems was begun in this laboratory in 1920, shortly after the writer's return from war service, but it was not till the International Health Board of the Rockefeller Foundation assisted us with a grant of funds in August, 1922, that any serious attempt could be made to tackle these problems in the field or in laboratory

The results of investigations on the lines outlined above will be applicable to the control of hookworm disease in other islands in the tropics in due proportion to the similarity between their soils and climatic conditions and those of Ceylon.

General conclusions regarding the epidemiology

of hookworm disease should be based on a comparison between accurate observations made in a variety of stations in the tropic zone. Similar problems are being investigated under the auspices of the Board on somewhat similar lines in various other parts of the world, particularly in Trinidad and Porto Rico. A series of reports from American observers have recently appeared in the "American Journal of Public Health."

In what follows an attempt will be made to briefly consider the more important phases of the inquiry and to show what is being done to throw light upon the problems at issue.

Egg Output.—The degree of hookworm infestation of the sewage works and the Narahenpita trenching ground depends primarily on the number of female hookworms harboured by the population of Colombo.

The number of eggs passed in the fæces per female hookworm is a variable quantity. Recent research by Stoll using his recently introduced technique puts the figure at about 9,000 per diem.

The writer has devised a method for roughly estimating the average output of viable eggs by the people of the city. It is based upon counts of the number of larvæ cultivated per gramme from a representative mass of night-soil.

Now that the results of the cultivation technique can be checked by accurate egg counts, it would seem worth while to apply this method to complete the results obtained from the hookworm survey of the town organized by Dr. Marshall Philip in 1919.

According to the results of this survey 40 per cent. of the general population of the town are infected with hookworms, i.e., there are about 100,000 people continually discharging hookworm eggs within the city limits.

The true measure of the degree of hookworm infestation of a population is the average number of worms per individual, i.e., the worm index. Darling has worked out a technique for ascertaining the worm index of population groups, but it is extremely laborious and only accurate if the group is for the time being under full control of the observer. Assuming a worm index of only one per inhabitant, the number of eggs formerly buried each day at Narahenpita would exceed one thousand million. The number now passing into the sewers is certainly not less.

548 of the positive cases found in the course of the survey were clinically examined, 279 showed no symptoms at all of hookworm disease, 222 were slightly anæmic, 46 were evidently anæmic and exhibited marked signs of hookworm disease.

No uniform relationship exists between severity of symptoms of ankylostomiasis and number of hookworms harboured by a particular individual. The presence of a few worms is sometimes associated with marked signs of disease in individuals exceptionally susceptible to the worm toxin; on the other hand, several hundreds of worms have been borne without apparent effect upon the health and energies of their host.

The data obtained in recent surveys in America indicate that where no other anæmic-producing disease is prevalent, such as malaria, the sub-division of the infected population into groups on the basis of the clinical signs corresponds with the grouping according to number of worms carried and egg output. The worm index of a group showing recognizable signs would be upwards of fifty. An index of 1,000 represents a very heavy infestation likely to be associated with severe or even fatal illness. The incidence of malaria in Colombo is insignificant. Ankylostomiasis is the only notable prevalent anæmic-producing disease, so that we are justified in inferring from the clinical results of the survey that the worm index must be low.

The number of viable eggs per gramme of night-soil from a latrine at Wellawatta corresponded roughly to a worm index of ten.

Egg Hatching.—The essential requirement for egg hatching seems to be a sufficient supply of oxygen in the hatching medium. In the absence of oxygen hookworm eggs do not develop. How long can they remain viable in a favourable anærobic medium is still unknown.

Till recently it was generally supposed that eggs buried in a few inches of soil or discharged into a sewer or cesspool would be unable to develop. The writer buried fæces containing numerous hookworm eggs at various depths up to three feet under soil from the Madampitiya and Narahenpita trenching grounds and under ordinary cabook. If the fæces were well mixed with the soil at the bottom of the pit abundant larvæ were developed, but if masses of fæces were simply covered over development only took place on the surface of the fæcal mass. Similar results have recently been obtained in the West Indies. The comparative failure of raw fæcal cultures has been noted by American observers and attributed by them to the development of high acidity. The more vegetable the diet the greater the acidity, and the fewer the larvæ hatching out. It would seem therefore that only a small proportion of the ova buried in night-soil at Narahenpita would be in a position to develop into larvæ.

The conditions found at the sewage works are also unfavourable to the hatching out of hookworm eggs. In the laboratory eggs deposited at the bottom of flasks containing crude sewage or septic tank liquors failed to develop if air was excluded from the flasks. The development which took place in the sump of the Maligawatta pumping station and subsequently in the sumps of other pumping stations is probably to be attributed to the proximity of a ventilating shaft passing down to the sewer close to the pumping station. Moreover, several of these pumping stations are close to the "tipping depots" where night-soil is tipped on to screens and flushed into the sewers so that a concentrated dose of fresh ova must enter the sumps each day.

Borland McVail found hookworm eggs and larvæ in the effluent of nineteen out of fifty-six septic tanks in Bengal sewage works. These tanks were

unmodified. They are now being reconstructed by the authorities in Bengal with a view to reducing gasification and obtaining improved sedimentation. Ova in unmodified tanks are not only constantly brought to the surface and given access to oxygen, but rapidly carried through into the effluent.

The work of reconstructing the tanks at the northern treatment works, begun in 1915, was finished in 1920. Few larvæ now pass through the modified tanks, only one was found in thirty litres of effluent, and none in fifteen kilogrammes of sludge. It is not possible as yet to be so definite as regards ova. No other worm likely to be met with in the human intestine produces eggs resembling those of hookworm, but the worms of certain nematodes parasitic in domestic animals lay similar eggs, which are difficult to distinguish from those of human hookworm and liable to be found in sewage.

Larval Growth.—After hatching from the egg hookworm larvæ pass through a series of developmental changes, occupying about five days at average Colombo temperature, till they reach the stage when they become infective and are capable of penetrating the human skin.

During this period of growth, food granules are stored up in the body cells. These granules serve to nourish the mature larvæ till it reaches the trachea of its human host.

The immature larvæ are much less resistant to unfavourable conditions than the infective forms. Under the usual conditions obtaining in nature, only a comparatively small proportion of the larvæ hatched out of the eggs will reach maturity.

The most favourable culture medium for hookworm larvæ appears to be vegetable humus or mould such as is produced by the decay of vegetation on the surface of the soil. In addition to this kind of substance, air, enough, but not too much, moisture, and a suitable temperature are required. The presence of acid or certain salts is detrimental to the larvæ.

The dark gravelly loam at Narahenpita contains the high figure of 6·7 per cent. of humus, but is distinctly acid in reaction Ph. 5. 4. In other respects it seems well suited to the development of hookworm larvæ. Rich yields of infected larvæ have repeatedly been obtained by mixing infected human fæces with both Narahenpita earth and mixture of equal parts of sand and dried sludge from the septic tanks. As will be seen later, these larvæ survived for an exceptionally long period. They must therefore have been exceptionally well nourished.

The yield of larvæ obtainable from soil cultures varies greatly with the nature of the soil. Stoll reports 2·4 per cent. larvæ hatched from ova in Porto Rico clay and 66·7 per cent. larvæ from humus in the same locality. Sandy and sandy loam soils are intermediate.

Colombo can be divided roughly into areas where the soil is of cabook and other areas where it is principally composed of sand.

Bare cabook is somewhat deficient in the type of organic matter required for the development of hookworm larvæ. Once development took place, as it might on a surface layer of vegetable mould, the larvæ could survive long periods in moist cabook. Their movement, however, would be restricted to within a few inches of the surface.

Sandy regions are especially liable to hookworm infestation; especially where the sand overlies an impermeable stratum so that the ground water level is high.

If the surface of such a soil were well mixed with garden earth or humus, the conditions would become almost ideal for the development and survival of hookworm larvæ.

Larval Activities.—The movements and general activities of the mature infective hookworm larvæ are very characteristic and remarkable.

Placed in water in a shallow cell, the active larvæ exhibit frequent lashing movements, eventually finding their way to the margins of the cell where they remain head outwards in a continual state of agitation.

Movement increases with rise of temperature to blood heat. At lower temperatures movements may not be continuous, larvæ sometimes passing into a resting stage during which there is practically no expenditure of energy.

Larvæ in soil are found in the moisture film covering the soil particles. Their action is exerted between the resistance of the particle and the surface tension of the moisture film.

After travelling some distance through soil larvæ became noticeably more transparent, due to loss of their food granules, which when numerous render them opaque. The smaller the size of the soil particles, the greater the surface tension of their moisture film, the greater the resistance to larval movement and the more rapid the exhaustion of the larval store of energy, which cannot be replenished from without.

Observations made in the laboratory indicate that in a soil such as cabook, permeable to water, but resistant to larval motion, larvæ will remain more or less stationary for long periods if water is regularly added.

Till recently the idea prevailed that hookworm larvæ had great powers of lateral diffusion from an infected focus. This is certainly not the case. The slight lateral migration detected in Colombo soil was easily accounted for by the mechanical action of the currents set up after addition of water to the soil. Observations in the West Indies lead to a similar conclusion.

If the moisture content of the zone surrounding the infected fæces be artificially increased on a horizontal plane lateral migration will take place, but such conditions can seldom occur in the field.

Till recently many sanitarians considered that hookworm fæces could safely be buried under a shallow layer of earth without risk of the larvæ developing and ascending to the surface. Recent research shows that burial affords no such security, unless the soil is restrictive of larval movement.

Colonial Medical Reports.—No. 175.—Colombo (*con nued*).

Hookworm larvæ move upwards or downwards, according to the amount of moisture present in the different levels of the ground; if the ground surface is drying they descend to moisture levels; if the upper layers of the soil are moist they ascend till they reach the surface.

The extent of the vertical movements of hookworm larvæ appears to be governed principally by three factors:

(1) The size of the soil particles.

(2) The distribution of the ground water.

(3) The amount of energy stored up as food granules in the body of the larvæ.

Mature larvæ are usually provided with a sheath, which protects them to some extent from adverse influences. After moving even a short distance through compact cabook the sheath is lost.

Loss of sheath is much less marked after passing through a light sandy soil of the Narahenpita type. Only 20 per cent. of the larvæ added to cabook can be recovered by Baermann's method, whereas more than 80 per cent. can be isolated from Narahenpita soil.

Preliminary experiments were made in January and February, 1923, on the vertical powers of ascent of hookworm larvæ. Stools heavily infected with hookworm larvæ and the filariform larvæ of *Strongyloides stercoralis*, after mixing with earth, were buried at the bottom of pits dug in hard cabook near the laboratory to the depths of 6, 12, 18, and 36 inches. The shallower pits were filled with coarse river sand, Narahenpita soil, and loose cabook. Both species of larvæ ascended six inches through all three soils, and hookworm larvæ twelve inches through each soil, and through eighteen and thirty inches through sand.

It was proposed to repeat these experiments with definite quantities of larvæ, but in the meantime Florence Payne in America has published a report of such experiments in which numerous larvæ were recovered after an ascent of thirty-six inches through sand. She found in her experiments that the larvæ were unable to penetrate white clay, but ascended ten inches through a red clay.

The behaviour of hookworm larvæ in the surface of soil is of particular interest. Van Durme in 1902 drew attention to the remarkable attitude taken up by the filariform larvæ of *S. stercoralis* on the surface of particles of soil. Subsequently, it was found by other observers that both human and canine larvæ behave in a similar manner.

Larvæ attach themselves by one end to a particle of soil, preferably of fibrous nature, and extend themselves into the air. According to the writer's observations the motion of hookworm larvæ in this position is a slow to and fro wave movement as if continually reaching for a new support. The *S. stercoralis* larvæ exhibit a rapid jerky motion.

Florence Payne reports that larvæ do not expend much energy in maintaining this position, judging by the rate of disappearance of their food granules.

The larvæ may be observed to move from particle to particle on the surface by a species of looping motion. The aerial position is kept up for periods varying from a few minutes to half an hour or so at a time. Larvæ commonly cling together in aerial clusters which are readily visible to the naked eye on the surface of the soil. The surface of cultures of canine hookworm ova may be covered with waving plumes of larvæ.

The significance of this phenomenon seems clear. Perched in a favourable position on the surface of the soil the larvæ await their opportunity to come in contact with the human skin.

So far as known to the writer only infective nematode larvæ of the penetrative type behave in this manner. The free-living soil nematodes, though often very active in their movements, remain in the interstices of the soil.

Immediately contact is made with the skin a new set of forces comes into play leading to the penetration of the epidermis, the passage of the larvæ to the lungs, hence to the bronchi, trachea and œsophagus. Full development takes place in the intestines, if the host is adapted to the species of worm. *N. americanus*, the Ceylon species of hookworm, has only two hosts, man and the gorilla. The series of forces which brings the larvæ on to the surface of ground moistened by rain, thence to the summit of the soil particles, or as high up as leaves and twigs or the moisture film extends, thence into the skin, are analogous to the forces causing a plant to bend towards the light, or which drive a spermatozoon to its destination, the unfertilized ovum.

Pintner named the force thigmotropism, which causes the larvæ to penetrate small pores. Brumpt has called the driving force larvæ into tissues histotropism. Khalil has recently described under the name of thermotropism the tendency of hookworm larvæ to move towards a heated point. The tendency of larvæ to extend themselves into the atmosphere may be called aerotropism.

It is sometimes difficult to separate hookworm larvæ present in soil from the free-living forms having a somewhat similar appearance.

If a greater variety of larvæ are recovered from a mass of soil the task of scrutinizing them all under the microscope in order to make an accurate count of the hookworm larvæ is often excessively laborious.

Progress in hookworm research work has been mainly a question of development in technique. It was Baermann's discovery in 1917 of a convenient and reasonably quantitative method for isolating nematode larvæ from soil, which gave the impetus to modern research into the epidemiology of hookworm disease.

The writer has sought to facilitate the task of separating hookworm larvæ from free-living forms by taking advantage of the tropic reactions described above. It was found that hookworm larvæ will penetrate porous membranes such as filter paper, chamois leather, or buckskin with great ease. Non-porous leathers, parchment, rubber and similar substances are not penetrated. Larvæ penetrate into a membrane made of freshly dissected skin, but seldom pass through it.

The next step was to bring a membrane retaining a suitable fluid at blood temperature in an inverted tube or vessel lightly into contact with the surface of soil containing larvæ. The aerially extended larvæ then pass upwards through the membrane into the fluid, where they may readily be recovered free from soil particles and almost free from non-infective larvæ. The results are somewhat affected by the temperature of the atmosphere. It may be necessary to cool the under side of the receptacle containing the soil. A buckskin membrane was commonly used in these experiments.

A curious phenomenon was noted during these investigations (September, 1922, to January, 1923). If a pan of soil showing numerous aerially extended larvæ be placed in the incubator at 37° C. all the larvæ disappear from the surface of the soil. They re-appear in a few minutes at room temperature on the laboratory bench.

The technique can be adopted to any quantity of soil.

A second test found of value is that of applying the suspected larvæ to the skin of a rat. If the suspected larvæ are able to reach the lung of the rat within three days with production of hæmorrhagic congestion of the organ the result of the test is considered to be positive. Both canine and human hookworm larvæ give positive results to this test, provided sufficient numbers of larvæ are applied to the skin. Penetrative nematode larvæ of other species should doubtless give similar results. Free-living larvæ give negative results.

Tests of this kind cannot entirely replace the crucial experiment of applying the larvæ to the human skin and expelling any hookworms developed but enable such troublesome experiments to be reduced to a minimum.

Larval Life.—The viability of the infected hookworm larvæ is clearly a matter of great epidemiological importance and has accordingly been studied by numerous observers in various parts of the world.

Most of the workers in temperate climates were able to keep the larvæ alive for upwards of a year. Baermann in Sumatra observed living larvæ up to six months in a shady soil.

A series of reports, however, has recently been issued by the team of American observers working under the direction of W. W. Cort, placing the extreme length of survival of hookworm larvæ in the tropics at six to eight weeks. The experiments were carried out in Trinidad. The number of larvæ present in the soil diminished rapidly, both in the field under natural conditions and in laboratory experiments.

This conclusion, if correct, would justify a more optimistic view of our prospects of controlling the spread of the disease. The risk of infection from walking barefoot over such sites as that at Narahenpita or of handling sludge at Madampitiya would become negligible in a few weeks.

Before describing the results of the series of observations made in the laboratory, the principal factors governing the length of life of hookworm larvæ in soil may be briefly considered.

Stress has already been laid on the effect of rich culture media in supplying the larvæ with a good store of food granules during their development from the egg to the infective stage. Larvæ grown under poor conditions cannot be expected to live long. A constant supply of moisture is essential to long larval life. Much depends on the temperature; comparative observations made in this laboratory at room temperature 80° F. and in the incubator show that larval die out twice as rapidly at blood heat both in soil and in liquids. This is due to the increased larval activity produced by rise of temperature and the more rapid exhaustion of their food reserve. The constitution of the soil is of importance; in fine soils much more energy is wasted in reaching the surface. Acid soils and soils containing excess of salt are most unfavourable to the larvæ.

Similar results, therefore, can only be expected under similar conditions.

Observations were made on the length of life of hookworm larvæ both in the field at Narahenpita and in the laboratory in various soils contained in pots and jars, and in a trench in the laboratory grounds.

The Narahenpita trenching ground was divided into blocks and each block into numbered trenches. To prevent waterlogging the trenches were covered with ridges of earth. Abundant crops of grass are raised on the site and sold as cattle food. The whole area was trenched over in about eighteen months. As accurate records were kept of the numbers of the trenches dug each day in any block the number of days since night-soil was buried in any particular trench was definitely known.

The observations, begun in 1920, were brought to a conclusion some months after the closing of the depot on June 27, 1922.

Larvæ apparently identical with hookworm larvæ could be recovered in small numbers from the soil of trenches up to 113 days old.

A report by Mhaskar has just appeared on the survival of hookworm larvæ in a similar trenching ground at Trichinopoly, India

Larvæ were recovered up to fourteen weeks (ninety-eight days).

On December 21, 1922, heavily infected human fæces were buried in an eighteen-inch trench dug in the cabook behind the animal house at Maligakanda. The trench was watered daily. The day before the writer left the island for Europe a few larvæ were still present in the soil of the trench, i.e., eighty-eight days after the commencement of the experiment.

Conditions in the field are variable, particularly as regards rainfall. A rapid increase of larval mortality may be produced by a spell of dry weather or some other temporarily unfavourable factor.

What the sanitarian needs to know are the maximum length of survival and some idea of the rate of mortality under the most favourable conditions likely to be met with in his locality. To throw light upon this problem a series of

laboratory experiments were carried out, in which an attempt was made to eliminate the influence of unfavourable factors. The results of the more important experiments are summarized in the following schedule.

Number	Nature of soil	Kind of receptacle	Number of days larvæ survived	Rapid falling off in numbers after
1	Sand and sterilized sludge equal parts mixed with infected human fæces	Baking pan	124	68 days.
2	Sand and sterilized sludge equal parts mixed with infected human fæces	Baking pan	108	87 days.
3	Sterilized Narahenpita earth with hookworm stool	Baking pan	124	89 days.
4	Sterilized Narahenpita earth with hookworm stool	Baking pan	120	78 days.
5	Sterilized Narahenpita soil finely sieved	Pot	14	1 day.
6	Sand and unsterilized sludge	Pot	9	1 day.
7	Unsterilized cabook soil	Pot	120	69 days.

The two inches of earth in the pans was protected from flies by wire gauze, covered with a layer of wood ash and watered daily with a sufficient uniform amount of sterile distilled water to keep it slightly moist. The pans were perforated for drainage. The pots were ordinary flower pots of the cylindrical pattern. Larvæ cultivated from human fæces were placed in the upper three inches of the soil in the central axis of the pot. There was very little lateral and no downward migration.

Sterilized soils were only heated sufficiently to kill any nematode larvæ present and not enough to markedly affect their chemical composition.

The rapid disappearance of the larvæ in experiment No. 5 was undoubtedly due to the impermeability of the finely sieved soil to water. A solid crust formed on the surface. In its natural condition, full of coarse matter, root fibres, &c., this soil is readily permeable to water. The disappearance of larvæ in experiment No. 6 may be attributed to putrefactive changes in the soil. Swarms of protozoa were present which may have had a detrimental influence on the larvæ. Numbers of dead larvæ were recovered from the pots showing much the same degenerative appearance as larvæ kept in septic tanks for over three days. These two experiments serve to illustrate the operation of unfavourable factors on the survival of hookworm larvæ.

Some of the larvæ kept in tubes filled with Colombo tap water exhibited active movements of translation up to the ninety-eighth day. A few could still be stimulated to move a little after nine days.

The larvæ in all these experiments became more and more transparent with increasing age.

The results of the Trinidad experiments show a rapid larval mortality from the first few days of the experiment.

The larval numbers did not fall off rapidly in the course of four of the Colombo experiments till about the seventieth day.

On the basis of the writer's results six months would seem a fairly safe limit for the survival of hookworm larvæ under conditions likely to be met with in Colombo. During the hot dry weather the viability of the larvæ would be much less, whereas up country it would be probably much greater.

More information is required concerning the rate of re-infestation after treatment. This rate seems the best epidemiological guide to the sanitary state, qua hookworm, of any particular district. The rate depends not only on the degree of hookworm infestation of the soil itself, but also on the sanitary habits of the population group.

Baermann was disappoined to find that heavily infected coolies working in rubber and tobacco estates in Sumatra, after a thorough course of treatment for hookworm disease, became steadily re-infected till finally after one or two years they harboured an average of about 738 worms and consequently urgently required another course. The average number of worms acquired per day rose from ·75 to 1·3 per coolie. Latrines were used in these estates. Baermann traced the source of infection to patches of larvæ-infected soil in the neighbourhood of these coolies' dwellings. The larvæ were probably brought to the spot originally in particles of fæces adhering to the coolies' feet after a visit to dirty latrines. Each day the coolies had occasion to visit the infected spot and acquired additional infection.

As hookworm do not die out rapidly in the common Ceylon soils investigated there would be ample opportunity for the establishment of infective foci on the surface of the ground, especially in those districts unprovided with latrines.

The continued infectivity of these soil foci would depend upon the balance in between the rate of death of old, and the rate of development of new, larvæ in the same situation. A vicious cycle tending to continually increase human infestation would become established under particularly unfavourable conditions as regards soil infestation.

It is difficult to know what interpretation to place on the epidemiological data relating to the Madampitiya outbreak in 1919. The conclusion arrived at by several independent investigators, that hookworm larvæ must have survived in the soil at least two years is not likely to be accepted in the present state of our knowledge without absolutely convincing evidence.

The results of the writer's investigations do not exclude the possibility that hookworm eggs or larvæ may, under a specially favourable combination of circumstances, remain in a dormant or resting stage in the soil for extraordinarily long periods.

It is probable, however, that larvæ seldom survive for such exceptional periods under tropical conditions.

There are three principal measures for the control of hookworm infestation among a barefooted population.

(1) Periodic treatment campaigns.

(2) Provisions of sanitary latrines and education in their use.

(3) Paving or hard packing of the ground surface in the vicinity of dwellings.

The relative utility of the third measure increases

in proportion to the viability of larvæ in the soil covering the ground near human dwellings.

An infestation rate of 40 per cent. of the population is somewhat high for a well-latrined city such as Colombo and is probably to be accounted for by the suitability of much of the soil for the development and survival of hookworm larvæ.

Though there is little actual hookworm disease due to the direct action of the parasites, yet this degree of infestation must have a considerable indirect effect in lowering the general vitality of the population and decreasing their powers of resistance to more serious diseases.

The steady increase which is taking place in the number of water carriage latrines and of hard paved surfaces near human dwellings should bring about a gradual decrease in hookworm infestation throughout the city and a corresponding improvement in the public health.

CONCLUSIONS IN REGARD TO CONTROL OF HOOKWORM DISEASE.

(1) The reconstruction of the septic tanks at the sewage works has not only improved the effluent chemically and physically, but diminished the risk of hookworm larvæ passing out with the effluent or sludge.

(2) The sludge from the septic tanks may be safely sold as manure after being thoroughly sun-dried and kept in dry store for six months.

(3) The site of the Narahenpita trenching ground is now free from hookworm infestation derived from buried night-soil.

(4) The labour force employed in clearing the sumps and sewers are exposed to grave risk of contracting hookworm disease. The sumps of pumping stations should be emptied as far as practicable by mechanical means. Coolies should not enter the sumps or sewers without adequate protection for their feet and hands.

(5) Hookworm larvæ are capable of ascending a considerable distance through loose soils. Hookworm infected fæces cannot be buried in such soil without risk of infecting the surface of the ground.

(6) Hookworm larvæ cultured in soils rich in organic matter can survive at least four months in typical Colombo soils.

Colonial Medical Reports.—No. 176.—Seychelles.

ANNUAL REPORT ON THE MEDICAL DEPARTMENT OF SEYCHELLES FOR THE YEAR 1923.

PUBLIC HEALTH.

Vital Statistics.

THE estimated population of the colony on December 31 was 25,700, and the birth-rate was 30·62 per 1,000 and the death-rate 11·79 per 1,000.

There were no infectious or contagious diseases treated during the year.

The excellent work carried out by the Rockefeller Institution in combating the hookworm infection should not be allowed to lapse. Over 80 per cent. of the population is heavily infected; with the increase of staff in 1924, as far as local means will permit the campaign will be continued. The same remark applies to leprosy, when the campaign will be commenced on modern lines as soon as the necessary injections arrive from England. Compared with other tropical places the colony compares favourably, the death-rate is low, there is no malaria, at times sporadic chicken-pox occurs, and with the exception of leprosy, amœbic dysentery and an odd case of beriberi from the outlying islands most tropical diseases are unknown.

Syphilis is prevalent and gonorrhœa is common, and these two diseases, coupled with ankylostomiasis, are responsible for most of the ills of the community. The usual parasites of the nematoda, such as *Ascaris*, *Trichocephalus dispar*, *Filaria*, *Strongylus* and *Oxyuris* are quite common.

Leper Camp, Round Island.

Formerly the Leper Camp was situated on a little island close to Praslin, but three years ago it was removed to Round Island, situated in Victoria Harbour, about two miles from the mainland. The lepers are each provided with a wooden hut, and they are better housed and fed than people of their condition in civil life. There are at present fourteen lepers in the camp, all males, each provided with his own small house, there is a guardian in charge and a dresser is also attached to the camp. The supply of rations is good, and a medical officer visits the camp at least once a week, oftener if necessary.

Lepers are prohibited from taking part in occupations that would directly or indirectly bring them into contact with food or drink intended for others. The main Ordinance gives power to segregate pauper lepers and lepers of well-to-do families on a responsible person signing an agreement to look after them and see that they carry out the restrictions laid down by law. We have twenty-five lepers segregated and looked after by their next-of-kin, they are visited from time to time by the Sanitary Officers and if they do not comply with the regulations there is power to intern them in the leper camp.

The upkeep of the leper camp for 1923 was Rs. 3,397.95.

Colonial Medical Reports.—No. 177.—Sierra Leone.

ANNUAL MEDICAL AND SANITARY REPORT FOR SIERRA LEONE FOR THE YEAR 1923.

General Remarks.

Freetown was free from epidemics of any sort; outbreaks of yellow fever were reported from several ports on the Gold Coast and plague was reported from some of the neighbouring French and Spanish possessions, necessitating the enforcement of quarantine regulations for short periods; no case of either of these diseases occurred in the colony.

The Cape Quarantine Station was requisitioned once during the period for contacts (some sixty in number) from a German boat, on which was found a case of confluent small-pox; there were no other cases.

There were sixteen cases of chicken-pox and two cases of small-pox treated at the contagious diseases buildings at Kissy flats.

General Diseases.—Rare; the following were observed: pernicious anæmia, one; exophthalmic goitre, two; rickets, three; lymphadenoma, two; gout, one.

Rheumatism.—Acute rheumatism and rheumatic fever are not common; chronic rheumatism—articular and myalgic is fairly widespread.

Dysentery.—There was an increase of fifty-four in the number of this disease treated in 1923.

Tuberculosis.—This for the last four years shows a steady and somewhat alarming increase; the increase is more evident amongst the Creole population, which is not surprising in Freetown, when one realizes the overcrowding of houses, want of air space and ventilation, and the apparent overcrowding in the houses themselves.

Venereal Diseases.—Gonorrhœa and syphilis show a steady increase in the numbers treated.

The figures in these diseases are only the cases treated by Government medical officers, and one fears they are not all representative of the true numbers. Whether the disease be gonorrhœa or syphilis, the native, through indifferent or persistent negligence, fails to come for treatment until almost incapacitated; in the meantime he may be spreading the disease far and wide.

Communicable Diseases.

Insect Borne. Yellow Fever.—There was no case during the year. Yellow fever restrictions were observed for a short time owing to the suspicious illness of a European in the nursing home; however, the post-mortem cleared all doubts and all restrictions were removed; during the time of restrictions a very useful lot of fumigation and intensive anti-stegomyia work was effected.

Trypanosomiasis.—One case was discovered in a child while attending out-patients; she was removed to hospital, but before treatment could be completed she was taken away by her parents against the advice of the medical officer in charge and lost sight of; she was supposed to be a native of Sherbro.

Malaria.—This disease is widespread, both in the Colony and Protectorate. It is, however, gratifying to note a decrease of 1,609 malarias and three blackwaters during the year; the good effects of the anti-malarial measures, taken wherever the sanitary department is, are bearing fruit in no uncertain manner.

Infectious and Epidemic Diseases.

Small-pox—Freetown.—One imported case, one non-imported case. Protectorate—some seventeen cases were reported from various parts of the Protectorate; no deaths were notified.

Chicken-pox.—This disease was reported fairly frequently both in Freetown and the Protectorate; sixteen cases were isolated at Kissy.

Measles.—This disease was common in the colony and Dr. Taylor reported on an outbreak in the Port Lokko district, where there were eighty cases, with six deaths.

Beriberi.—Including the forty-three cases at the prison fifty-five cases were treated.

Fuller details of these diseases are given in the sanitary section.

Helminthic Diseases— Ankylostomiasis.— This disease is widespread; each medical officer submits an annual special report on this disease. All these diagnoses are based on microscopical examinations. Treatment by carbon tetrachloride, thymol or beta-naphthol or oil of eucalyptus gave satisfactory results.

Ascaris was found in 1,296 of the cases examined and *Tænia solium* or *T. saginata* in 146 cases.

Preventive Measures against Insect-borne Diseases.

The following is taken from the report of Dr. J. M. Mackay, M.C., Acting Medical Officer of Health, Freetown:

House to House Inspection.—98,002 inspections of houses and compounds were carried out during the year, 578 mosquito breeding places being found.

Mosquito Breeding Places.—The total number of mosquito breeding places discovered and dealt with was 1,121.

Closing of Wells.—At the end of 1922 there remained, so far as was known, only two wells to be closed. These were closed during 1923 in addition to four others, whose presence had not previously been detected. Practically all wells have now been closed.

Cesspools.—The usual disinfecting during the dry season and oiling during the rains was carried out.

Canalization of Streams.—Towards the end of the year, Alligator, Sanders and Nicol's Brook were regulated and canalized, all mosquito breeding pools, &c., being filled in.

Filling in of Low-lying Land.—A considerable area of low-lying land in the vicinity of the new concrete drain in Sanders Street was raised and drained, thereby obliterating a great number of potential mosquito breeding places.

Oiling of Pools and Gutters.—40,122 pools and gutters were oiled by inspectors in charge of sections and 26,035 by the oiling gang which operated for six months.

Inspection of Trees.—During the latter half of the year, a systematic inspection of trees was carried out. 25,046 trees were inspected and 5,352 holes, likely to contain water in which mosquitoes might breed, were found. 2,900 of these holes were cut so as to prevent water lodging there and 2,452 holes were cemented. 111 mosquito breeding places were found.

Yellow Fever.

The death of one European in Freetown, which occurred in September, was attributed on clinical grounds to yellow fever, but pathological examination showed that death was due to a streptococcal septicæmia.

Trypanosomiasis.

Trypanosomes of the *gambiense* type were found in the blood of a child who was brought to the Cline Town dispensary. Unfortunately, the patient disappeared after the diagnosis was made, and all efforts to trace her were unsuccessful.

The Registrar at York, who is a dispenser, recorded one death in an outlying village as probably due to trypanosomiasis, but he did not see the case and the diagnosis was based on a description of symptoms given by the relatives.

In accordance with recommendations made by Prof. Blacklock in a report published in the last annual Medical and Sanitary Report (Appendix viii), fifty prisoners were sent to the Cape Sanitary Station early in October and for the remainder of the year they were employed in clearing the Cape Peninsula with a view to getting rid of the tse-tse fly. On former occasions it had been assumed that the oil-palms on the Cape Peninsula were of economic value and the method of treatment adopted was merely to remove the lower petioles in order to deprive the fly of breeding shelter. It is now realized that owing to extensive tapping for the purpose of obtaining palm-wine the trees have become valueless, except from the æsthetic point of view. It was therefore decided to cut down all trees low enough to provide shelter for the fly and leave only the tall ones. By the end of the year this had been done on about half the peninsula and, if certain difficulties with regard to privately-owned land can be overcome, it will be continued until the whole of the peninsula has been cleared. Efwatakala grass was grown from seed in the compound of the sanitary station and this will be planted out at the beginning of the next wet season.

Relapsing Fever.

In consequence of reports of this disease from the Gold Coast and of its recent extension in a severe form over a large area of French West Africa, medical officers in this colony were warned to be on the look-out for it. Dr. Maplestone, assistant director of the Sir Alfred Lewis Jones Research Laboratory, Freetown, kindly examined a series of blood-films taken from cases of fever in various parts of the colony and protectorate. All of these were negative for spirochætes, and Dr. Maplestone stated that he considered it "unlikely that relapsing fever is at present endemic in this colony."

Preventive Measures against Infectious and Epidemic Diseases.

Cerebrospinal Meningitis.

A solitary case at Pujehun, which was considered by the medical officer to be cerebrospinal meningitis, was notified in August. The cerebrospinal fluid was purulent and showed microscopically "numerous masses of degenerated leucocytes with diplococci in pairs and short chains of pairs intra- and extra-cellular." Death occurred on the tenth day and there was no post-mortem.

Plague.

In Freetown, 13,168 rats were brought to the department during the year and were destroyed. They were paid for at the rate of 2d. each until September, when the rate was reduced to 1d. During the year Dr. Maplestone, of the Sir Alfred Lewis Jones Research Laboratory, carried out a series of examinations of rats for *B. pestis.* No infected rats were found. The department continued to use rat-catching varnish, which proved as before to be highly satisfactory. There is a sufficiently large percentage of *X. cheopis* present on rats in Freetown to carry plague effectually in epidemic form, should this disease be imported. The great difficulty is of reducing the rat population owing to the vast amount of natural shelter. Modern experience indicates that the only satisfactory method of getting rid of rats is to build them out, and this is a point worthy of serious consideration when building regulations are drafted. A town-planning scheme with a view to getting rid by degrees of the congested areas of Freetown would do much to reduce the danger of plague which, under existing conditions, is an ever-present one.

Small-pox, Chicken-pox, Vaccination.

In Freetown two cases of small-pox were notified during the year. One was a non-imported case on the western outskirts of the town, but the source of infection could not be traced. The other case was landed from the German S.S. "Tsad." Seventeen cases were reported from the protectorate, nine of

these from the Koinadugu district of the northern province and the remainder from the southern province. Chicken-pox was reported fairly frequently both in the colony and protectorate. There was an outbreak, consisting of seventeen cases, at the Agricultural Training College at Njala, the source of infection being a boy who came from a town in the southern province, where chicken-pox was prevalent.

Dysentery.

It is difficult to give accurate figures with regard to the incidence of dysentery. At the Colonial Hospital, Freetown, 138 cases were treated in 1923. Now that the wells in Freetown have been closed it is unlikely that this disease is to any extent waterborne and, as flies are seldom numerous, it is improbable that they have much to do with it. Its continued prevalence is probably to be attributed to "carriers" and to insanitary conditions of living, especially as regards the handling and storage of food.

Leprosy.

Three new cases were treated at the Kissy Infirmary. Others reported were three in Freetown Prison, four at Daru and three at Bonthe.

It is hoped that when the natives begin to realize that the new methods of treatment hold out promise of cure they will bring their cases more readily to the various dispensaries, as has already happened in India, and that in time real progress will be made in the eradication of this disease.

Tuberculosis.

There is reason to believe that tuberculosis, especially the pulmonary form, is very prevalent in Freetown and that it is increasing. Eighty-three cases were treated at the Colonial Hospital in 1923. The African has none of the resistance, inherited or acquired, to this disease that the European possesses, and he is liable to fall an easy prey to it. There can be little doubt that congested areas and overcrowded and insanitary dwellings have a great deal to do with the prevalence of this disease in Freetown. It is probable that ankylostomiasis and other helminthic infections are important predisposing causes. The risk of infection through meat or milk is almost entirely absent and we have to deal no doubt with the human strain, transmitted by close and direct contact in small ill-ventilated rooms.

Anthrax.

Dr. J. M. Mackay, M.C., Acting Medical Officer of Health, Freetown, reports as follows: "During the year three cases of anthrax amongst cattle were discovered. The first case was found on January 16, a cow which had died on that day. The second case occurred on February 5, also a cow which died on that day. The third and last case was found on December 10. This was a bullock which, on inspection before slaughter, appeared to be quite healthy. After slaughter the condition of the spleen was suspicious, and on bacteriological examination *Bacillus anthracis* was demonstrated. One sheep also died of anthrax on March 12. No case of human anthrax was discovered." At Bo two bullocks suffering from anthrax were destroyed.

Diphtheria.

Two cases of diphtheria, treated at the Princess Christian Mission Hospital, were notified by Captain Wade, R.A.M.C. As far as can be ascertained these are the first cases recorded in this colony.

Other Diseases.

Measles was prevalent during the second quarter of the year in the colony and it was also reported from the Port Lokko district of the protectorate. Eighty-five cases were treated at the Colonial Hospital, eighteen at Kissy, twenty-eight at Songo and forty-eight at the Port Lokko dispensary. As a rule the type was mild, but in an outbreak at Magbankitta, in the Port Lokko district, there were nine cases with six deaths.

Whooping-cough was also prevalent in the colony during the second quarter; 109 cases were treated at the Colonial Hospital, Freetown, seventy-five at Bonthe and thirteen at Waterloo.

PORT SANITARY WORK, FREETOWN.

The Port of Freetown was never in quarantine during the year. All ships arriving from infected places were visited and inspected by the Medical Officer of Health. One case of small-pox was discovered on the S.S. "Tsad" in July and the usual precautions taken, viz., disinfection of the ship, vaccination of contacts and the isolation at the Cape Sanitary Station of all persons landing in Freetown.

A case of scarlet fever was landed from S.S. "Boutry" in February and treated at the Kissy Infectious Diseases Hospital. This steamer was homeward bound after a stay of some weeks at various West African ports and the source of infection could not be determined.

VITAL STATISTICS.

The death-rate of 30 per thousand in Freetown compares with a rate of 26·3 in 1922, the actual number of deaths being 1,332 in 1923, an increase of 171. In view of the fact that only 17 per cent. of the deaths were certified by a medical practitioner, it is difficult to state the exact reasons for this, but it is worthy of note that there was an increase of 106 in the deaths under three years. With the exception of measles and whooping-cough, in the second quarter, there was no outbreak of infectious disease during the year. A study of the deaths month by month shows that the increase was spread over practically the whole of the year and was most marked in the months of April, July, August, October and November. Generally speaking, the highest death-rate occurs during the wet months of the year.

NURSING HOME AND COLONIAL HOSPITAL.

Blood.—Eight hundred and thirty-one samples examined chiefly for suspected malaria. *Plasmodium falciparum* was found on 207 occasions, *P. vivax* on four and *P. malariæ* on four occasions also. The results emphasize the fact that the vast majority of cases of malaria in Freetown are of the so-called malignant type.

It is a very exceptional occurrence to find the sexual forms of this parasite in the peripheral blood of the patient. In one case only during the year were they observed.

As the presence of these cells is necessary for the transmission of malaria from one case to another, it will be of interest to find if they are more common in nocturnal blood.

Ninety-two specimens of sputum were examined, in fourteen of which *Bacillus tuberculosis* was found.

Twenty-three specimens of pus, chiefly from cases of suspected venereal disease, were examined. One specimen taken from the nose was found to contain *B. lepræ*. Four hundred and two specimens of fæces were examined, in which were found ova of *Ankylostoma*, *Ascaris lumbricoides*, *Trichuris trichiura*, *Tæniidæ* and *Entamœba histolytica*, either in cyst or as free forms.

The comparatively low percentage of cases harbouring ankylostome ova is explained by the fact that the majority of patients from whom these results are obtained are accustomed to wearing boots or shoes and so one of the chief roots of infection (i.e., through the skin of the feet and ankles) is closed. The percentage of patients harbouring ankylostome ova in the Freetown Prison is considerably higher.

REPORT ON ANKYLOSTOMIASIS, BERIBERI, AMŒBIASIS, LEPROSY AND BILHARZIASIS IN FREETOWN PRISON.

Ankylostomiasis.

The prisoners found infected were treated by different methods and the stools examined for adult worms. At the end of a week the fæces were again examined for signs of infection. Those found negative were re-examined weekly until three examinations had proved negative. Those found positive were given a second course of treatment and the same method of examination followed. One prisoner still found positive was given a third course and his fæces examined in the same way. Unfortunately, a large proportion of the prisoners (being short sentence men) were discharged before the full routine could be carried out, therefore the results are incomplete. All cases were under identical conditions, being admitted to the prison hospital during week-ends and kept in bed on low diet. No ill-effects were observed during or after any course of treatment.

Methods of Treatment.

A.—Beta-naphthol 40 gr. (in powder) followed in one hour by thymol 30 gr. and mist. alba 4 oz. after four hours. B.—Carbon tetrachloride 30 to 45 minims on bread. C.—Ol. eucalypti 30 minims, chloroform 40 minims, ol. ricini 10 dr., divided into two doses with one hour interval. D.—Ol. chenopodii 30 minims in milk.

No oil of chenopodium was in stock and a very small quantity only was obtained privately from Dr. J. E. Wright.

Conclusions.

Beta-naphthol.—Thymol is the most successful form of treatment, while eucalyptus is a failure, in dealing with ankylostome infection in Freetown Prison, but further work is necessary on account of the small numbers dealt with and the incompleteness of records owing to discharges.

Beriberi.

It is now possible to give details of the 1922 outbreak which lasted well into 1923. The total number of cases was 63. Of these, eighteen relapsed after being apparently cured; several relapsed twice and even thrice.

Number of deaths, three; number released on medical grounds, five; average stay in hospital, nine weeks.

Treatment.

Various combinations of tinct. ferr. perchlor, ferr. et ammon. cit., tinct. digitalis, liq. strychninæ, acid. phos. dil.

The most successful in the wet type of case was R: Mist. diuretica 1 oz. (pot. acet., spt. juniper, hyosc., and scoparii). Tinct. digital. 5 minims to 10 minims, tinct. nux. vom. 5 minims, aq. ad. 2 oz., t.i.d.

Amyl nitrite.—Inhalations were found of great benefit in tiding bad cases over thoracic crises.

Dry yeast, moistened and made up into pills, was administered, dose from ½ dr. twice daily.

Marmite.—1 dr. twice daily was used for one case with no marked beneficial results.

Diet.—Bread, 12 oz.; agidi, 1 lb.; beef, ½ lb.; sugar, 2 oz.; rice, 3 oz.; lard, ½ oz.; salt, ½ oz.; pepper, ¼ oz. For a time ½ lb. bread and ¼ lb. sweet potatoes were substituted for the rice without much benefit.

Extras—Barley water, milk, beef-tea, sweet potatoes, groundnuts, bananas, pawpaws, tomatoes and oranges.

In August, 1923, the four chronic cardiac and ataxic cases resulting from beriberi were released, thus bringing the outbreak to an end.

Amœbiasis.

An attempt was similarly made to deal with prisoners infected with amœbic cysts (*Entamœba histolytica*) i.e., those who were serving as carriers for potential amœbic dysentery. Owing to the discharge of short sentence men it was impossible to deal with all those found infected.

Method of Treatment.—One examination only of each was made. Those found positive were treated with:

A.—Tabella emetine c. bismuth. iod. administered thus: ½ gr. daily for two days, 1 gr. daily for four days—total 6 gr. Those found positive in a single examination one week after treatment received a second similar course.

Colonial Medical Reports.—No. 177.—Sierra Leone
(continued.)

B. Emetine hydrochloride administered hypodermically (in the case of weakly patients considered unfit for the more strenuous bismuth emetine iodide) thus: ½ gr. daily for two days, 1 gr. daily for four days—total 5 gr., followed where necessary by a second course of treatment.

Leprosy.

A more detailed account may be given of the two cases of leprosy treated during the first six months than could be done in the quarterly reports.

Case A.—Tribe—Temne—undergoing a life sentence—had been isolated on admission two years ago with a diagnosis of leprosy. He was considerably mutilated by the disease, and was unable to rise from the ground. He could barely crawl and had to be carried in the arms. Sensation was entirely lost, so much so that after two months' treatment, when a hypodermic needle was accidentally broken off in a vein, an incision was made, the vein picked up and the needle extracted without his being aware of anything having happened. His veins were at all times difficult to find, appearing and disappearing in different parts of his limbs.

Treatment.—Ol. chaulmoograe 750, chloroform 250, acid carbolici 10.

Of a mixture in these proportions 5 minims gradually increased to a maximum dose of 20 minims was administered intravenously daily for six days in each week for five months. Injections were made into veins in arms, back of hands, legs, over arch of foot, &c., wherever one could be found. If no vein could be discovered the injection was given intramuscularly. In all he received 81 intravenous and 13 intramuscular injections. One intravenous and one intramuscular developed into abscesses. At the end of this course he was given ol. chaulmoograe 30 minims on bread daily up to the present date.

Results.—The first sign of improvement was noted after three months' treatment, when he was able to stand if supported. The following month he was able to walk a little with the assistance of a stick, but still staggered and frequently fell. Progress continued steadily till the end of the five months, when he was able to walk upright without support or aid, and to ascend or descend stairs. Sensation has now been fully regained and for some time he has been doing light manual labour.

Case B.—Tribe—Mende—undergoing a sentence of two and a half years' hard labour and now on the point of discharge, was also diagnosed and isolated prior to my taking over the prison. He was shown to the local branch of the British Medical Association as a typical case of anæsthetic leprosy, large pale or pink-edged areas of anæsthesia covering much of the body and limbs, into which pins could be thrust almost one-fourth of an inch without the patient perceiving it.

Treatment.—The same mixture and dose but entirely intravenous, the majority of the injections being made into the same spot in the same vein day after day. After five months' treatment of 124 injections he was placed on treatment by mouth.

Results.—The majority of the patches have disappeared while sensation has returned in full.

Bilharziasis.

Two prisoners were found to be suffering from urinary bilharziasis. Both were Mendes, one from Kennema, the other from Pendembu. They were treated with antimony tartrate intravenously, ½ gr. dissolved in 10 c.c. normal saline gradually increased to a maximum of 2 gr. every alternate day, until a total of 25 gr. had been administered. Treatment in one of the cases had unfortunately to be suspended for three weeks, when only half the total had been administered, owing to the development of an abscess, and was resumed later. Active eggs were still present in the urine on conclusion of his treatment. He was given a few weeks' rest and a full course was then again administered, with the result that his urine was still negative some months later, although repeatedly examined during that time. The other case was negative, and remained so for some months after one full course of treatment. Both are cured.

Rat-Fleas in Freetown, Sierra Leone.

Hirst's (1923) work has attracted attention to the importance which must be attached to the relative proportion of various species of *Xenopsylla* on rats in places which appear liable to plague epidemics. He concluded from his observations that *X. astia* was a much less efficient transmitter of plague than is *X. cheopis*.

In Freetown a hundred rats sent by the Sanitary Department were examined during the months of January and February, 1923. The rats came from various parts of the town; the numbers were: black rats 62, brown rats 38. All the fleas removed from the rats were collected, a total number of 657. Of these, 654 belonged to the genus *Xenopsylla* and three to the genus *Ctenocephalus*. The 654 *Xenopsylla* comprised 419 fleas of the species *X. braziliensis* Baker (1904), and 235 of *X. cheopis* Rothschild (1903). The *Ctenocephalus* belonged to the species of *C. canis* Duges.

No *X. astia* were found on these rats; Evans (1922), however, records it among rat-fleas sent to her from the Gold Coast.

Xenopsylla braziliensis Baker (1904), was originally described from Sierra Leone, but its capacity for transmitting plague bacilli has not so far been worked out. Whether it exhibits that relative inability which Hirst attributes to *X. astia* in Ceylon is unknown.

It is of interest to note that Newstead and Evans (1921), who examined 469 black rats from ships in Liverpool (59 of these rats being obtained from ships coming from various West African ports) do not record any *X. brasiliensis* from 469 rats examined, whereas they found 489 *X. cheopis*. Again, Balfour (1922) did not report any *X. brasiliensis* on 34 black and 444 brown rats obtained mostly in

London, whereas he reports *X. cheopis* on 5·9 per cent. of the black rats and 3·6 per cent. of the brown rats. Hirst (1923) states that *X. brasiliensis* is found on the rats of West Africa, South America and the uplands of Peninsular India.

Cragg (1920) states that *X. braziliensis* is not common in India and cites Poona, Mangalore, Bombay City and Ootacamond as the only places from which it had then been recovered by him.

Owing to the smallness of the numbers of West African ship rats examined here and in Liverpool it is not yet possible to say whether *X. brasiliensis* is capable of remaining alive during transport on ships to England.

Whether *X. braziliensis* is a plague-transmitting flea or not, it appears from our figures that there is a sufficiently large percentage of *X. cheopis* present on rats in Freetown to carry plague effectually in epidemic form should this disease be imported.

The number of rats in Freetown is large, and owing to the extensive area which is at present capable of providing natural shelter for them, it is evident that vast numbers would survive any ordinary efforts at reduction.

The city of Freetown possesses many quarters in which the native population is overcrowded, and it also contains a large floating population. All these factors are of importance in the case of plague epidemics. The chief protection of this port from the introduction of plague from other coastal regions in the past is probably the absence of a deep water wharf.

Report on an Investigation into the Prevalence of Goitre in the Protectorate of Sierra Leone.

Introduction.

This investigation into the prevalence of goitre in certain districts in the Protectorate of Sierra Leone was undertaken during the months of December, 1923, and January and February, 1924. The districts traversed were the mountainous Konno and Koinadugu districts, but parts of certain tribal areas outside the limits of those districts, e.g., part of the Mende country, part of the Limba country, and part of the Temne country also came under review.

Past and present theories about Goitre.—Before entering on a detailed statement of the conditions found in Sierra Leone, it is convenient to analyse first the various theories and suggestions which have been advanced as to the causation of goitre, and then later to show in what respects the facts in Sierra Leone conform to such theories. The influence of heredity, sepsis and other factors will be mentioned later.

Geographical Theory.—Formerly endemic goitre was considered to be mainly a geographical and geological disease; it was held that it occurred only in countries situated far from the sea at a high altitude, and in certain geological formations. The influence of meteorological conditions was considered important and of such rainfall, damp, and absence of sunshine in valley situations were most frequently emphasized.

Deficiency and Excess Theories.—Arising in part out of the geographical theory, and connected with it, are certain theories which have been current for many years and which attribute the enlargement of the thyroid gland to the absence from or excess in food or water of certain constituents which are essential to the normal functioning of the thyroid gland. In Gippsland, Australia, insufficiency of lime in the food or water has been considered to be the chief factor in producing mild goitrous symptoms; the success of treatment there by the administration of calcium salts seemed to bear out the correctness of this theory. On the other hand, in Derbyshire and Switzerland thyroid enlargement and enlargement of the parathyroids have been attributed to excess of calcium salts.

In the year 1896 Baumann, of Freiburg, discovered in the normal thyroid gland an iodine-containing substance, to which he gave the name thyro-iodin. This finding had a definite bearing on a theory then already held by some in Switzerland that it was a deficiency of iodine which was the cause of thyroid hypertrophy. It was now proved that the thyroid gland of goitrous persons differed in chemical constitution from that of normal persons by being deficient in iodine. This discovery appeared to confirm the idea that the thyroid gland of goitrous persons is deficient in iodine, because of a natural deficiency of iodine in the food and water ingested.

The Infective Theory.—For a period the idea that goitre arose as the result of infection by micro-organisms gained ground. McCarrison (1913 to 1914) stated "I have adduced evidence to show that the causal agent of the disease (endemic goitre) is a micro-organism which, having its habitat in the soil of endemic localities, gains access to the bodies of men and animals by means of water, soil-contaminated food, soil-contaminated hands or other means, and living in the alimentary tract of the infected individual gives rise to those toxic products which, on absorption to the blood-stream, stimulate the thyroid mechanism to increased activity. In a certain portion of all cases this increased activity results in the development of visible goitres, and is the starting point of those many degenerative processes which ultimately involve the hypertrophied organ." The idea of a living organism being *directly* responsible for the enlargement by infection of the thyroid itself or by general infection of the blood, was negatived by certain experiments conducted by the same author; he proved by cultural methods that fœtal goitre in goats did not yield living micro-organisms. From this date onwards the micro-organismal nature of the disease has been studied carefully; the less recent developments of the micro-organism theory were rather in the direction of showing that the organism exists not in soil but in fæces of goitrous men and animals, and is capable of producing goitre in healthy animals which are fed on such fæces or on cultures prepared from such fæces. The suggestion here, as before,

is that the organism, having reached the alimentary tract of the healthy animal or man, proceeds to grow there and produce its toxins, which are absorbed, and then cause the stimulatory effect on the thyroid gland. More recent developments of the theory suggest, however, that the organism exists, not only in goitrous fæces, but also in non-goitrous fæces. Further, that it not only exists in the non-goitrous fæces of man, but also in that of goats, rats, pigeons and other animals. Most important of all, this theory has been linked up with the iodine-deficiency theory by making the organismal infection responsible, by means at present not quite understood, for producing the deficiency of iodine.

We have thus in goitre to-day two schools of experimental research which are predominant. The one is developed from the old empirical observation of the endemic coincidence; this has become the iodine-deficiency theory of the present day, largely as the result of the work of Baumann; its operation is seen in the preventive and curative work which is being achieved in the Swiss endemic areas, in America and elsewhere. The other is the organismal theory, but now so modified that while its supporters admit that deficiency of iodine in the human system is the proximate cause of goitre, they claim that the existence of such deficiency is dependent on and primarily due to the fæcal organism or organisms which have been proved to have the effect of producing goitre when administered by the mouth in culture or otherwise. According to the iodine-deficiency theory, there is a natural lack of iodine in the food and water of certain places; according to the micro-organism theory, the lack of iodine is not a deficiency natural to the food and water, but is an artificial one produced by the active intervention of fæcal organisms which have been ingested. The mechanism of production of iodine deficiency in the human system has recently been the subject of further research, and the suggestive observation has been made that certain fats and oils when taken in excess prevent the system from absorbing sufficient iodine for its needs from a diet which contains iodine in an adequate amount. Certain oils, on the other hand, such as cod-liver oil, which contain an appreciable amount of iodine, while they may exercise a detrimental effect, *quâ* oil, on the absorption of iodine, are yet—because of their own iodine content—not only incapable of producing goitre, but are even capable of preventing the development of goitre in animals fed on fæcally-contaminated food, a diet which would certainly produce goitre in the absence of some such vehicle of iodine.

The Scope of the Present Investigation.—With the object of ascertaining, if possible, whether a natural deficiency of iodine in the water of certain areas would account for the known incidence of goitre in the endemic districts, it was decided that, as part of the investigation, a direct test should be applied. This test consisted in taking a river which passes through a portion of the endemic area and tracing it up to its source in the mountains; by this direct method it was hoped to obtain valuable information on the much-debated question of iodine deficiency. It appears reasonable to suppose that if goitre occurs on a river some distance from its source, and if this goitre is due to a natural deficiency of the river water in iodine, then on tracing the river to its ultimate origin in mountain springs we shall find greater, or at least as great, numbers of persons affected with goitre at the higher levels. A river with many villages on its course is evidently the best calculated to provide the information; for this purpose the river Bagwe seemed well adapted, because not only does it traverse a large portion of the endemic area, but also there are many villages situated on it, and last of all its sources, which lie within the territory of Sierra Leone, are accessible. The results of the examination of the villages at the Bagwe source will be set out in detail in their proper sequence; it will be shown that the results obtained have importance relative to the iodine-deficiency problem.

Inspection of Population.—The total number of people who underwent examination for goitre was 2,508, of whom 1,547 were males and 961 females. Persons with enlarged thyroid were found in twenty-three villages to the number of 426, of whom 176 were males and 250 females. Not all of these cases, however, had acquired their goitre in the village where they were examined; in certain cases a definite history was obtained which proved that the condition had been acquired elsewhere. A fact which appears to require emphasis here is that Protectorate village children often travel in early youth from the village in which they are born and in which they subsequently reside. It is a not uncommon custom for mothers to take their young children back to their own villages on a visit at a period soon after the child's birth. In such cases it is not always possible to state with certainty that these children were not exposed to goitre-producing causes at their mothers' villages. As far as possible, all persons with such doubtful histories were excluded from the figures of the particular village in which they were discovered. This correction reduced the totals for classification as follows: Of thirty-seven villages examined twenty-two had cases of goitre present in a population of 2,465; among 1,532 males there were 161 with goitre, and among 933 females 222.

Relative Incidence in Males and Females.—It is seen that of 1,532 males examined 161 or over 10 per cent. had goitre, while of 933 females examined 222, that is over 23 per cent., had goitre. The difference in the totals of males and females coming to be examined was accounted for in various ways by the chiefs. Fear of the white man, fear of vaccination, fear of being operated on for goitre, occupation, and similar reasons were given. The fact that smaller numbers of women presented themselves for examination would not, however, produce any increase in the percentage of females who proved to have goitre, unless it is assumed that those females who had goitre remained for

examination in greater proportion than those who had no goitre. As a matter of fact, it is probable that the reverse was the case and that proportionately more females with goitre stayed away than those without goitre. On several occasions it was stated by the chief that women whom he knew with goitre had stayed away for fear of operation; this was verified in some villages where such women with goitre were produced late in the day after being reassured by their companions on this subject. It appears, therefore, that we may accept the large relative preponderance of females affected with goitre in the villages visited as a fact.

The findings in Sierra Leone as regards the sex incidence of goitre correspond with those in other localities where goitre has been studied. In a place where goitre exists in endemic form it more commonly affects females than males. Many reasons for such a relatively large incidence in females have been suggested; the most commonly given being physiological ones which associate increased susceptibility of the female thyroid to hypertrophy, with the temporary enlargements of the gland which accompany normal functions in the female, e.g., menstruation. That is to say, that given an adult population of males and females of the same age, equally exposed to these influences which produce pathological enlargement of the thyroid gland, the females will be more affected because their thyroid mechanism is naturally more easily disturbed than is the case with males. There is some evidence that even in animals which are living in districts where goitre is endemic there is a tendency among the females to greater thyroid morbidity. McCarrison (1914-1915) noted that in the goitrous district of Sanawar thyroid hyperplasia occurred more frequently in female than in male wild rats.

Septic Conditions as a Factor.—It is stated that thyroid enlargement may result from a septic focus in the body; it is not suggested that all septic sores, and toxic conditions and septicæmias have this effect. Curiously enough, such effect is stated to be produced usually by a septic focus situated in the tonsils, nasal sinuses, or teeth. No evidence was found of such casual relationship during the investigation. At Kaivima the personal and family history of twenty-eight cases of goitre was taken in some detail, and at the same time an examination was made and any physical abnormality noted. A septic condition of the mouth was found in eight cases; the degree of the septic condition and its frequency were not greater than that found in non-goitrous persons. While it is possible that in some cases the septic condition may have had a causative influence, it was not possible to find cases in which the influence of this cause could be estimated.

Prevention and Treatment.—The results recorded from the countries in which the prevention and treatment of endemic goitre are carried out by the supplying of iodine in some form are striking. Over a period of three years Drs. Maine and Kimball examined 10,000 girls in Akron, Ohio. Of those who had moderately enlarged thyroids and accepted treatment 79·7 per cent. showed a decrease in size of the glands; only 12·4 per cent. of those who did not accept treatment showed decrease; the totals accepting and refusing treatment being equal. In St. Gall, Switzerland, iodine prophylaxis was adopted for all the school children. In 1918 87 per cent. had thyroid; after a period of three years' iodine prophylaxis, in 1922 only 13 per cent. had enlarged thyroids.

Report on an Investigation into the Prevalence and Transmission of Human Schistosomiasis in Sierra Leone.

1. *Rectal Schistosomiasis.*—The examination of the fæces for the purpose of diagnosing this disease is attended with some difficulty among these tribes, both pagan and Moslem; to a less degree this applies also to the examination of urine. Great reluctance was shown by the natives throughout the investigation in allowing the examination of excreta. This is due chiefly to certain beliefs which these people hold concerning possible evil effects which may be produced by the person into whose possession such material comes. Fortunately, in some cases the chiefs and headmen were enlightened enough to assure their people that the white man did not possess sufficient knowledge to acquire evil power over them by such means. This assurance was effective usually to this extent, that the older and more influential people sent their young relatives to be examined. The number of persons in whose cases the examination of fæces was possible was 188, of whom 134 were males and fifty-four females. Only in one case—a female—were terminal-spined ova of *Schistosoma hæmatobium* found in the fæces, and this was possibly due to contamination from the urine, which was heavily infected. The figures are sufficiently large to show that rectal schistosomiasis due to *S. mansoni*, if it exists at all in this region, is rare; some further evidence supporting this view will be produced in the section dealing with the snails.

2. *Urinary Schistosomiasis.*—In thirty villages the urine of as many persons as possible was examined; any infected cases which had clearly acquired the disease in other localities were excluded from the figures.

3. *The Effects of Urinary Schistosomiasis on the Population.*—In many cases the disease was accompanied by definite severe symptoms, such as pain in the bladder region, in the back and over the liver; in most severe cases in adults there is an associated mental depression.

On the other hand, in many cases the existence of the disease was unsuspected by the persons affected. This does not necessarily mean that the individuals in this case do not suffer; it may simply mean that the true cause of any symptoms experienced by them is overlooked because the urine does not contain visible blood. Between the two extremes mentioned lies the vast bulk of the cases: these suffer from definite symptoms, and the disease from time to time causes sufficient pain and inconvenience to prevent the infected persons from pursuing their usual avocations with any activity.

Colonial Medical Reports.—No. 177.—Sierra Leone
(continued.)

The best evidence that the disease is troublesome to them is their readiness to submit to treatment. As soon as the severely affected persons observed that the intravenous injection of antimony resulted in relief of symptoms, as well as the clearing up of blood in the urine, numerous applications for this treatment were received. Natives do not as a rule submit themselves readily to such a treatment unless they are suffering considerable discomfort. One unfortunate thing about the treatment of schistosomiasis by this means is, that it relieves symptoms and signs rather too early. Its value as a means of general application for the eradication of the disease is thereby unexpectedly limited. For as soon as the native feels well he fails to present himself for further treatment, and no amount of explanation will convince him of the necessity for continuing the treatment. For this reason, if no other, it would undoubtedly be an unwise policy to entertain any serious hope of the eradication of schistosomiasis by this method in these large native populations.

Native Views on Schistosomiasis.—The native names for this disease are various, each tribe having a name of its own for the condition; these names were invariably translated into English by the interpreters as "red gonorrhœa." It is recognized by the natives examined that there is a "white gonorrhœa" and a "red gonorrhœa." This has sometimes led to confusion in the minds of Europeans, when the word gonorrhœa has been used without the qualifying adjective; it has surprised them to be informed by the parents that a young child is suffering from "gonorrhœa." No adequate explanation could be offered by the natives of the causes which produce "red gonorrhœa"; the problem appears to be too profound for solution by their usually acute methods of observation.

The Identification and Bionomics of the Snail or Snails which act as Intermediate Host in this Country.

An extensive list of aquatic and non-aquatic snails was collected during the three months expedition; only the aquatic forms need be mentioned here. The aquatic snails found were dissected and examined for the cercaria stage of the parasitic worm.

Ampullaria balanoidea (Gld.) was the commonest of the aquatic snails found. It was usually present in large numbers on the sandy bottom of streams and in relatively clean water. Dissection of it in various localities did not reveal infection with cercariæ of any kind. It was found very widely in all districts visited. *Planorbis* (*Hippentis*).—This was found only at Jiama (Nimmi Yemma) Konno country.

Physopsis sp.—nearly allied to *globosa* (Morel). It was found to contain cercariæ which morphologically appeared to be those of *Schistosoma hæmatobium* and which were subsequently proved to be so by means of infecting animals (guinea-pig and monkey) with them, and obtaining adult worms.

Infection of Physopsis with Cercariæ of Human Schistosomes.—The figures given show that of 1,557 specimens of *physopsis* dissected 306 had cercariæ of some kind present in their tissues. Out of the 306 there were 184 infected with the cercariæ of *S. hæmatobium*, which was the only schistosome parasite affecting the population examined. In some cases where cercariæ of *S. hæmatobium* were found other cercariæ were also present in the same snail. Again, in snails from some localities, little or no infection of any kind was found; the variable rate of infection from different localities was a very striking phenomenon.

Locality	Number of *physopsis* dissected	Numbers infected with cercariæ of *S. hæmatobium*	Per cent.
Jiama (Nimmi Yemma) ...	497	12	2·4
Jiama (Nimmi Korro) ...	200	18	9·0
Bendu	160	18	11·2
Taiko	48	8	16·6
Kaiyima	373	112	30·0
Paya	50	21	42·0

On considering the factors which result in the production of a high rate of infection in these snails, it was found that the infection rate was directly proportional to the contamination of the water supply in a village by human excreta. One section of the village goes to a spring for its drinking water. The path to this spring passes through a shallow muddy pool into which comes the water from the men's latrine situated a few yards away. From the spring a stream runs towards the village and turns sharply into a wet rice field just before reaching the pool mentioned. The spring and the upper part of the stream from it yielded no *physopsis;* the water ran on a bed of coarse sand. Lower down towards the village a layer of mud had formed on the sand and a few *physopsis* were found here. On following this stream to the rice field, where it became lost in marshy ground, *physopsis* was easily found, usually on weeds or on the underside of fallen leaves; many were in the mud and came to the surface after the mud had been trampled down.

Methods of Prevention of the Disease.—Enough has been said to show that the prevalence of the disease and the morbidity resulting from it are sufficiently great to deserve attention. It has been said that while we have in antimony a very powerful and efficient drug for the treatment of cases, it would be unwise to attempt its use on a large scale here with the idea of eradicating the disease. It appears that other means than this must be adopted, as we know that if infected snails remain the people will become reinfected.

Sanitary education is the true and practical solution of this problem here.

Colonial Medical Reports.—No. 178.—Cairo.

REPORT OF THE MEDICAL OFFICER OF HEALTH, CAIRO CITY, FOR THE YEAR 1921.

Vital Statistics.

Population.

The mid-year population of Cairo for 1921, as estimated by the Statistical Department, was 765,200, consisting of 692,057 Egyptians and 73,143 foreigners. To this population should be added that of the area around Helwân proper. This population, which has been estimated at 29,025, added to that of Cairo amounts to 794,225.

Births.

There were 36,914 births in Cairo during 1921. This total shows a still further increase on the annual totals of the last eight years, and is 930 higher than in 1920.

Deaths.

The total number of deaths which occurred in Cairo during 1921 was 24,177, which is the lowest total during the last eight years.

Infantile Mortality.

The total number of infantile deaths during 1921 amounted to 8,252, including 143 deaths of children coming from outside Cairo, which occurred in various public institutions.

The total deaths belonging to Cairo proper was, therefore, 8,109.

The death-rate for 1921 is the lowest during the last eleven years.

As in former years, the main cause of infantile deaths was diarrhœa, the total number of deaths from this disease being 3,384.

Infectious Diseases.

The total number of infectious diseases notified during 1921 was 4,759, excluding 351 cases coming from outside Cairo.

Of this total there were 1,479 cases of influenza, which only became notifiable in August, 1919. This year shows an improvement on the previous seven years.

Regarding the totals of the individual eight principal diseases, all are well below the average totals during the last eight years.

The total of other diseases amounted to 2,733. They include 1,479 cases of influenza, 384 of whooping cough, 408 of mumps, 1 of leprosy, 25 of tetanus, 232 of chicken-pox, 198 of rabies, 1 of Malta fever, 4 of encephalitis lethargica, and 1 of acute poliomyelitis.

This shows a considerable increase of whooping cough, mumps and rabies, as compared with previous years, especially as regards rabies.

Small-pox.—The total number of cases of this disease notified during 1921 only amounted to five, with one death. So that it will be seen that this total is the lowest that has occurred for many years.

Measles.—The total number of cases of measles during 1921 was 282. The number of deaths was 108.

Scarlet Fever.—The total number of cases of this disease during 1921 was 66.

Diphtheria.—The total number of cases notified in 1921 was 438. The total is the lowest (excluding 1920) as compared with the previous eight years.

Typhoid Fever.—The total number of cases notified this year was 669, which is 256 fewer than in 1920, when the total was the lowest since 1913.

Typhus Fever.—The total number of cases of this disease during 1921 was very low when compared with the previous six years, the whole amounting to 385.

The campaign, instituted during March, 1920, with a view to combat the source of this disease (and Relapsing Fever), was continued throughout 1921.

Relapsing Fever.—There were 167 cases of relapsing fever notified during the year and eight deaths.

Cerebrospinal Fever.—The total number of cases of this disease which were recorded this year was fourteen, with five deaths.

Influenza.—During 1921 there were 1,479 cases notified. The number of deaths as recorded from influenza was 110.

The number of deaths from all respiratory diseases, excluding tuberculosis, was 3,824, out of which 1,419 were from pneumonia, 2,217 from bronchitis, 27 from pleurisy and 161 from other respiratory diseases.

Of the 1,419 deaths from pneumonia 820 were of children up to five years of age, 46 from over five to fifteen years, 182 from over fifteen to thirty-five and 301 over thirty-five.

The prophylactic measures carried out during 1921 were the same as those followed in 1920.

Anthrax and Shaving Brushes.—As stated in the last annual report Law No. 21 of 1920 by Article 3 empowers the Government to prohibit entirely the importation of shaving brushes in cases where it is considered that the Certificate of Disinfection accompanying them does not sufficiently guarantee their freedom from Anthrax infection.

This article was applied in the case of Japan by Arrêté of April 7, 1921, and the importation of shaving brushes manufactured in that country is now prohibited.

Government Fever Hospital, Abbasiya

The very unsuitable mat huts which were in use for the annual summer epidemics of the past five

years have been removed, and in their place five pavilions have been erected with walls formed of asbestos-cement sheets. Two pavilions still remain to be completed.

These pavilions will be cool in summer and warm in winter.

Compound for the Hospitalization of Military Infectious Cases.—Up till 1920 little except small-pox was admitted, most other cases of the milder infectious disease occurring amongst the military being isolated in a special military infectious disease hospital. Consequent on an agreement arrived at with the military authorities it was arranged that, in future, cases of infectious disease of all kinds, except cholera, occurring amongst the military units and their families on the married establishment should be admitted to the Government Fever Hospital to be accommodated in a special section to be built by the military authorities. The building of this section was completed in 1920 and put into use in 1921.

During the year 1921 there were 1,983 admissions to the Government Fever Hospital.

The admissions consisted of 20 cases of chicken-pox, 16 of measles, 27 of scarlet fever, 4 of cerebro-spinal fever, 47 of diphtheria, 100 of mumps, 688 of influenza, 18 of erysipelas and 9 of typhoid. In addition to these, 373 cases were sent to hospital under a mistaken diagnosis of infectious diseases, 37 persons were admitted under observation in whom no disease of any sort manifested itself and 91 mothers of young children and other persons accompanying patients were accommodated. The 373 cases sent to hospital under a mistaken diagnosis of infectious diseases were found on examination to consist: 40 of gastro-enteritis, 61 of malaria, 33 of pneumonia, 7 of bronchitis, 27 of tuberculosis, 3 of whooping cough, 45 of tonsilitis, 6 of dysentery, 9 of rheumatism, 6 of various skin diseases and 136 other cases of a most diverse nature consisting of syphilis, gangrene, tumour of brain, heart disease, &c.

The admissions from the eight principal notifiable diseases (measles, scarlet fever, diphtheria, typhoid fever, typhus fever, the relapsing fever and cerebro-spinal fever) were 647.

There were 159 deaths in the hospital during 1921.

Of these, 51 were due to typhus, 35 to typhoid, 1 relapsing, 6 to influenza, 15 to diphtheria, 1 to chicken-pox, 4 to cerebrospinal fever, 2 to erysipelas, 2 to tetanus, 7 to tuberculosis, 6 to enteritis and 12 to pneumonia.

In addition, there were 17 deaths amongst patients sent in under mistaken diagnosis of infectious disease and whose condition on arrival did not permit of a refusal of admission.

There were three concussion of brain, 1 septicæmia, 7 senility, 1 nephritis, 3 enteritis, 2 encephalitis and 1 hydrophobia.

Included amongst the third-class admissions were 111 sick convicts from Cairo Prisons. Of these, 6 were suffering from typhus, 10 from typhoid, 62 from influenza, 5 relapsing, 11 mumps, 2 paratyphoid, 2 tuberculosis, 1 enteritis, 1 septicæmia, 1 malaria, 1 dysentery, 2 erysipelas, 4 pneumonia and 1 glanders.

Of the convict patients 3 died, death being due to typhoid fever.

Vaccinations.

During 1921 there were 32,855 vaccinations carried out by the Medical Officers of the Inspectorate and Districts. 30,361 of these were primary vaccinations, of which 29,675 were on native children and 686 on children of foreign parentage.

The remaining 2,494 were secondary vaccinations of contacts of small-pox or of persons voluntarily applying for this.

Colonial Medical Reports.—No. 179.—Cairo.

REPORTS AND NOTES OF THE PUBLIC HEALTH LABORATORIES, CAIRO.

I.—The History and Progress of Anti-Ankylostomiasis and Anti-Bilharziasis Work in Egypt.

Historical Review on Ankylostomiasis and Bilharziasis in Egypt up to 1913.

Introduction.

Up to 1913, when a scientific advisory committee was formed in the Department of Public Health to advise on ankylostoma work in the provinces, no united effort had been made to check or ameliorate bilharzia or ankylostoma infections in Egypt.

At various periods in the past there were individual efforts to study and investigate these diseases in Egypt, resulting in brilliant discoveries regarding their ætiology, epidemiology and pathology. It is safe to conclude that our present knowledge It is safe to conclude that our present knowledge of these diseases is mainly a combination of the work done in Egypt at different periods with some additions from abroad. Outstanding names amongst the investigators are: Bilharz, Griesinger, Pruner and Looss, the German investigators; Leiper, Sandwith, Symmers and Madden, amongst the English, and Sonsino, the well-known Italian parasitologist. It

is to the efforts of these investigators that the country owes a deep sense of gratitude in affording a sure basis for the proper understanding of these diseases as a necessary step to combating their ravages.

Ankylostomiasis in Egypt.

Ankylostomiasis is endemic in Egypt. There is no evidence of its being introduced from other countries, and thus it was probably present in ancient times. A disease resembling ankylostomiasis is said to have been depicted by the ancient Egyptians, but it is yet doubtful if its causal agent was recognized at those remote periods.

Ankylostomiasis worms were first found in Egypt by Pruner in 1847 at the autopsies of Egyptians in Cairo. Till that time these parasites were considered as harmless organisms. It was Bilharz (1853) and Griesinger (1854), both teachers at the Cairo Medical School, who first connected the parasites with the extremely prevalent chlorosis noted in Egypt. The disease, for lack of ætiological factor, was then known as "Egyptian Chlorosis," or "Egyptian Anæmia." It was regarded by Bilharz and Griesinger to be the cause of more than one fourth of all deaths in Egypt.

The valuable observations of Bilharz and Griesinger were not followed up, but the interest in this disease was revived by Sonsino in 1878. This was followed by a period of great activity, both in the clinical aspects of the disease carried out by Sandwith and in the zoological aspect of the parasite and its life history by Professor A. Looss.

The researches of Professor A. Looss resulted in his discovery of the dermal method of infection by ankylostoma larvæ, one of the most far-reaching discoveries in parasitology in recent years. His monographs on the anatomy and life history of *Ankylostoma duodenale* published in the records of the School of Medicine, Cairo, are outstanding landmarks in the history of the disease.

In the early years of the present century an effort was made by Sandwith to treat ankylostomisas cases at Qasr el 'Aini Hospital, Cairo, on a large scale.

Up to 1913, however, no exact knowledge as to the incidence of ankylostomiasis in Egyptian villages was available. It was only indirectly inferred that the infection was widespread, judging from the incidence of infection in cases seeking medical advice at Qasr el 'Aini Hospital from different provinces of the country.

Bilharziasis in Egypt.

Bilharziasis has been traced definitely to ancient times. Ruffer (1910) demonstrated bilharzia ova in sections of kidneys from ancient Egyptian mummies of 1250-1000 B.C. Hæmaturia was one of the diseases recorded by the ancient Egyptians and prescriptions for the treatment of the condition have been discovered in medical papyri. It is, however, doubtful if the parasitic nature of the disease was recognized.

It was Bilharz in 1852 who first discovered the bilharzia worms in the portal system and connected them with the endemic hæmaturia common amongst the Egyptians. Subsequent to Bilharz's discovery several attempts were made to discover the life history of the bilharzia worms and of the method of infection of the human host. Sonsino, from 1874 to 1884, examined a large number of the snails of Egypt for the evidence of an intermediary stage of bilharzia worms. He was unsuccessful in his attempt, although his researches were valuable in determining other cercariæ in Egyptian fresh water mollusca. The subject was next taken up by Looss, who endeavoured for many years to discover the intermediary host, which he suspected to be a mollusc, but he was also unsuccessful. This led him to infer that no molluscan intermediary host was essential in the bilharzia cycle and that man himself acts both as a definitive and intermediary host, but his experimental attempts at proving this inference gave negative results.

The question of finally elucidating the life history of the bilharzia worm was left to Leiper, who in a series of brilliant and well thought out investigations carried out in Egypt between 1915 and 1918 definitely elucidated the life history. He was also able to prove that the urinary and intestinal varieties of the disease are due generally to two different species: *Schistosoma hæmatobium* and *Schistosoma mansoni* respectively, thus finally supporting the views of Sambon.

Up to the time of the discovery of the life history of the parasite no curative treatment was known. MacDonagh (1915), in his book on the "Biology and Treatment of Venereal Diseases," stated that he had succeeded in curing cases of bilharzia infection with tartar emetic. This statement attracted no attention, and it was the detailed reports of Christopherson upon the treatment carried out at the Khartoum Civil Hospital that introduced the drug into general use.

No exact data as to the extent of infection with bilharzia in Egypt were available before 1913, although it was concluded, from the high percentage of incidence among patients attending general hospitals, that the disease was possibly the most widespread serious malady in Egypt.

The following records are, however, significant:

Larry (1812-1817), in his "Mémoires de Chirurgie Militaire et Campagnes," stated that the symptoms of the disease, especially "hæmaturia," were frequent amongst the French troops during the Napoleonic expedition to Egypt (1799-1801).

Griesinger (1866) recorded that in 32 per cent. of 363 autopsies at Cairo he found evidence of bilharzia infection.

Sonsino (1874), in a series of 91 autopsies in Egypt, reported the incidence of bilharzia infection in 46 per cent.

In 1894 Kaufmann recorded from 500 autopsies that of 368 males 40 per cent. and of 131 females 11·5 per cent., *i.e.*, a general average of 33·3 per cent. showed evidence of bilharzia infection.

Colonial Medical Reports.—No. 179.—Cairo *(continued.)*

In 1910 Ferguson stated that his observations, based on considerably more than 1,000 post-mortem examinations at Qasr el 'Aini Hospital, revealed the presence of bilharziasis in no less than 40 per cent. of Egyptian male subjects between five and sixty years of age. Ferguson, as a result of post-mortem examination of 500 male subjects, ascribed the cause of death in 8 per cent. of all cases to the effects of severe bilharzial infection.

THE INAUGURATION OF THE ANTI-ANKYLOSTOMIASIS CAMPAIGN.

The first serious effort to check the ravages of ankylostomiasis in Egypt was undertaken by the Department of Public Health towards the end of 1913 on the initiative of Lord Kitchener. In his annual report of 1913 Lord Kitchener, referring to ankylostomiasis and bilharziasis, stated: " . . . . it is high time that serious steps should be taken to prevent the continuity of infection that has been going on so long in this country."

A Scientific Advisory Committee was formed consisting of the following: Professor Arthur Looss (president), Dr. A. F. Ferguson (secretary), Dr. C. Todd, Dr. H. B. Day and Dr. W. Hastings (members).

The function and purpose of the committee was to co-operate as a scientific advisory body with those directly responsible for dealing with ankylostomiasis in Egypt.

An ankylostomiasis annexe was established at Qalyûb. This was practically a travelling tent hospital with accommodation for 100 in-patients. The organization was carried out on lines similar to those on the Travelling Ophthalmic Hospitals in Egypt. The treatment was entirely free and voluntary, people who could afford treatment in their own houses were not admitted.

The whole field work was placed under the direction of Dr. MacCallan, Director of the Ophthalmic Hospitals of the Department of Public Health.

Modification in the Scope of the Work.

In addition to combating ankylostomiasis, it was found to be advisable to add to the work of the ankylostomiasis field hospitals the duty of collecting data as to the incidence and symptomatology of bilharziasis and pellagra.

In order to appreciate the good cause of such an addition, the endemic diseases of the country must be referred to. In Egypt there are four widespread diseases causing incapacity, chronic illness and death of a high percentage of the population. These diseases are bilharziasis, ankylostomiasis, ophthalmia and pellagra.

Ophthalmia was the first disease to be combated on a large scale, thanks to the magnificent initial gift of Sir Ernest Cassel of £E.40,000 the income of which was to be devoted to the relief of eye diseases in Egypt. The Egyptian Government has since undertaken the organization of ophthalmic hospitals, both travelling and stationary, all over the country. The value of the good work done is highly appreciated throughout Egypt, and the ophthalmic hospitals now represent an integral part of the Department of Public Health.

Bilharziasis and pellagra, at the time of the inauguration of the work (1913), were both diseases the means of spread of which were unknown and no certain cure for which was available. Ankylostomiasis, on the other hand, was curable in a high percentage of cases, although there was considerable difference of opinion as to the efficiency of the many drugs advocated. The method of infection, thanks to the work of Looss, was known, although how it occurred in nature and the details of prophylaxis were still left to be worked out.

1.—REPORT ON THE CAMPAIGN FROM DECEMBER, 1913, TO APRIL, 1915.

To the work conducted in Egypt there were two main features: *hospital work and survey work.* The first was directed to relieving the sufferers, the second to locating the areas of heaviest infection and the danger points in those areas from which the infection was spread. The survey work also attempted incidentally to establish, by clinical examinations, the degree of prevalence in Egypt of two other diseases: bilharziasis and pellagra. Travelling tent hospitals were established at convenient centres to which the inhabitants were invited to come for diagnosis and treatment. Infected persons were usually kept in the hospitals as in-patients until a complete anthelmintic course had been administered. The hospital work was confined to two provinces, Qalyubîya and Sharqîya.

The Rockefeller Foundation Grant.—The Director-General of the International Health Commission of the Rockefeller Foundation, Mr. Wickliffe Rose, visited Egypt in February, 1914, and made a careful study of the experimental arrangements for treating ankylostomiasis. As a result of his recommendations, the commission granted a sum of 30,000 dollars (£E.6,000) on the condition that the Egyptian Government paid an equal amount. Thus the sum of £E.12,000 was available during the financial year April, 1914, to March, 1915. The magnificent gift of the Rockefeller Foundation enabled the proper carrying out of the campaign on a larger scale than was originally anticipated.

Hospital Work.

The number of persons microscopically examined for ankylostoma infection during the period from December 13, 1914, to March 31, 1915, was 29,281. Of these 10,876 were found infected. The number of persons admitted to the hospitals was 11,280 of those found infected. 10,694 of those admitted were given full treatment and 450 were discharged before the completion of the full course of treatment.

Microscopic Examination for all Parasitic Worms.—In addition to the microscopic examinations for ankylostomiasis, specimens of urine were examined microscopically for bilharziasis. Other ova of intestinal parasites were incidentally recorded in addition to ankylostoma ova. 17,987 specimens of fæces were microscopically examined. The findings were as follows: 10,876 showed ankylostoma ova, 3,543 showed oxyuris ova, and 3,067 showed ascaris ova.

10,400 specimens of urine were examined for evidence of bilharzia infection, and bilharzia ova were detected in 5,821 of the cases.

Clinical Examinations for Diseases other than Ankylostomiasis.—Patients admitted to the hospitals with ankylostomiasis were subjected to microscopic examinations for bilharziasis and albuminuria and to clinical examinations for pellagra, œdema, enlarged liver, dilated heart and enlarged spleen. The total number thus examined was 10,397.

Hæmoglobin Index of Ankylostomiasis Patients.—Hæmoglobin tests (Tallquist) were made of the blood of 9,696 patients when admitted to the hospitals for treatment for ankylostomiasis. The average percentage of hæmoglobin on admission was 44. The average percentage of hæmoglobin of 4,031 patients, one month or more after treatment, was 49.

The majority of the cases treated for ankylostomiasis were between the ages of eleven and forty years.

Methods of Treatment for Ankylostomiasis.—(1) Treatment by thymol, three doses. *First day of admission*: Detection of ova in fæces. Physical examination and clinical note taking magnesium sulphate, two ounces in evening. Diet: Dinner only at midday.

Second, third and fourth days: Thymol, four grammes (sixty grains) in cachets; magnesium sulphate, two ounces; diet, dinner and supper.

Fifth day: Diet, breakfast only; discharge. (2) Treatment by oleum chenopodii.

This treatment was applied to children or others who were unable to take thymol cachets. *First day*: Midday meal; magnesium sulphate. *Second day*: 7 a.m., adult dose oleum chenopodii twenty-four drops on sugar; 9 a.m., adult dose oleum chenopodii twenty-four drops on sugar; 11 a.m., an adult dose castor oil seventy grammes, chloroform water forty-five drops. *Third day*: Repeat treatment if no ill-effects. *Fourth day*: Repeat treatment if no previous ill-effects. *Fifth day*: Discharge.

N.B.—(1) If there are symptoms of intoxication after the first dose of oleum chenopodii the treatment should be abandoned and a careful note made as to the signs of intoxication observed.

(2) If an evacuation of the bowels has not occurred by 1 p.m. an enema of soap and water should be immediately given. This should be followed by sodium sulphate thirty grammes whether or not the enema has been successful.

Survey Work.

Survey work was begun on October 1, 1914, and contined to April 8, 1915, when both hospital work and survey work in Egypt had to be abandoned because of the European War. The aim of the survey was to determine the extent and degree of infection with ankylostomiasis and to locate the danger centres from which the disease was spread. Incidental observations were made concerning the incidence of pellagra and bilharziasis. Two of the fourteen provinces of Egypt were selected for the survey. Sharqîya was selected as a typical province of Lower Egypt and Asyût as a typical province of Upper Egypt.

During the survey only males were examined owing to the difficulty in inducing females to submit themselves for examination. The survey of rural areas in the Province of Asyût was based entirely upon the examination of boys, who could be examined with less difficulty than men. The difference of incidence of infection amongst boys and men was found to be appreciable only in the town inhabitants, where it was the custom to examine 100 men and 201 boys.

Comparison of Infection.—Population of the two provinces surveyed, 1,756,230; number examined 10,153; number infected with ankylostomiasis, 5,175.

Infection with ankylostomiasis is more evenly distributed throughout the Sharqiya Province than throughout Asyût.

Method of conducting the Survey.—For securing the specimens the custom was to request the village headman by telephone, one day in advance, to have the required number of boys or men on hand at his house at a fixed hour on the following day. Each person was supplied with a tin box in which, in the presence of a village watchman, he had to place a specimen of his fæces. The boxes were later returned personally to the collector, who numbered them serially and then entered them in survey cards, one for each individual, bearing the number of the box, the name of the village district in which he lived, and the clinical data relative to other diseases.

Technique of Microscopic Examination.—From each specimen box a portion, the size of a bean, was taken and placed in a test-tube with water and thoroughly shaken. The emulsion thus formed was strained through coarse gauze into a centrifuge tube, one end of which had been previously corked, and twenty-four such specimens were placed in correspondingly numbered sections of the centrifuge. After rotation, the supernatant fluid was drained off, and by removing the cork the last drops were obtained. This was divided into two parts, mixed with an equal quantity of methylene blue, and spread on two slides. Search was then made for ova under a microscope equipped with a travelling stage. No specimen was considered negative until two slides had been examined each for the period of five minutes. When ova were

found by one physician, the fact was verified by the second physician looking down the other's microscope.

A test was carried out on seventeen specimens examined by the centrifugal method which were cultivated for larvæ. Two, which were positive to the microscope, gave a negative result on cultivation, and one which had been found negative was found positive by cultivation. Recent work not yet published on cultivation of ankylostoma fæces showed that 16 per cent. of the stools during summer in Egypt maintain an acid reaction, and in these no larvæ reach maturity. The larvæ die directly after hatching. The addition of calcium carbonate in small amounts to fresh stools ensures the success of cultivation.

The results of the survey represent the absolute minimum of infection. In view of the large number of specimens examined the results cannot be absolutely accurate, for a certain number of the eggs will escape detection. Another source of error may be found in the unsuitability and insufficiency of specimens supplied by boys. For example, out of twenty such specimens taken at random, five were in such small quantity as to prejudice the result.

Hæmoglobin Index.—In the entire survey work in Egypt, 2,923 specimens of blood were tested for hæmoglobin by the Tallquist scale with an average index of 61 per cent.

II.—Prevalence of Pellagra.

Only a cursory examination for pellagra symptoms was made, i.e., dermatitis on face, neck, hands and feet and enlarged parotids. The survey was conducted during the autumn or winter, when pellagra was seldom prevalent, so that the disease was not diagnosed unless it was very obvious.

Of the 10,153 persons examined, 250 were recorded as showing pellagra symptoms. Amongst 4,411 persons examined in Asyût, 89 were recorded as pellagras. Of the total of 543 prisoners, 14 were recorded as pellagras.

III.—Prevalence of Bilharziasis.

A crude estimate of the prevalence of bilharziasis of the bladder only was obtained in both provinces by listing as infected all those who stated that they had noticed blood in their urine. No microscopic examination of the urine was made. There is no doubt that that procedure grossly under-estimated the real condition of affairs.

Of the 10,153 persons who were questioned as to hæmaturia, 2,073 were classed as infected.

Presence of Birkas.—It was shown that the presence of *birkas* (ponds) does not bear an important relationship to the spread of ankylostomiasis.

Resumption of the Campaign in 1919.

The extension of hostilities to the Near East and the beginning of the Dardenelles Campaign unfortunately paralysed much of the work in Egypt, as a great demand was made on hospital accommodation for British wounded.

The work in the ankylostomiasis tent hospitals was discontinued on April 8, 1915. All the equipments were despatched to Alexandria together with all ophthalmic hospitals to form the Stationary Public Health Department Hospital at Glymenopoulo, of 650 beds, for the care of wounded soldiers.

Meanwhile, all ankylostomiasis work in Egypt was indefinitely suspended. When things returned to normal during the end of 1919, Professor Day, one of the original members of the Ankylostomiasis Consultative Committee revived the interest in combating this disease. In view of the discovery by Christopherson at Khartoum in 1918 of tartar emetic as a specific cure for bilharziasis it was thought advisable to include treatment of bilharziasis in the programme of the ankylostomiasis annexes.

Upon the suggestion of Professor Day an annexe was attached to Qasr el 'Aini Hospital under his direct supervision. This annexe was useful in establishing the principles of treatment to be carried out and in acting as a teaching centre for the physicians to be detailed for such work in the provinces.

Routine followed at the Provincial Ankylostomiasis and Bilharziasis Annexes.

Registration of Patients.—(1) A nominal daily roll is entered in a register book giving the name, age, sex and address of patients, a serial number being assigned to each patient. (2) An attendance card is given to each patient, to be presented whenever he returns for treatment or re-examination. (3) A treatment card is assigned to each patient; ankylostomiasis cards are yellow and bilharziasis ones red; the treatment is entered on the cards, together with the result of examination. (4) Index cards are arranged alphabetically according to the patients' names for identification in the event of a patient losing his attendance card.

Ankylostomiasis Division.—On registration the patient is given a bed pan into which he passes a stool for microscopical examination. Ankylostomiasis cases are seen by the medical officer, who takes a drop of blood for estimation of the hæmoglobin and enters the result on the treatment card. Patients who are too weak for out-patient treatment are admitted into the general hospital.

The treatment is as follows: oil of chenopodium is put in gelatine capsules, each containing 0·5 c.c. The ordinary dose for an adult is 1·5-2 c.c. (three to four capsules). The patient, who has been given a purge the previous evening, is given two capsules in the morning, sent to lie down for one and a half hours, when another one or two capsules are given. One hour after this last dose castor-oil (30 c.c.) is given. When the bowels have acted the patient is allowed to go home. He is instructed to return in about four days, when the treatment is repeated. He is usually supplied with an iron and arsenic

mixture to take for one week, and instructed to return. At his third visit the treatment is again repeated, another bottle of iron mixture is given to him and he is instructed to return after two weeks for re-examination.

Thymol is given in cachets after being well ground up in a mortar and mixed with an equal amount of sodium bicarbonate. Each cachet contains 0·5 gramme of thymol. The adult dose is 3 grammes (6 cachets). A saline purge should precede and follow thymol treatment. Three treatments are given in the same way as the chenopodium treatment.

Patients found on microscopic examination to be harbouring *Tænia saginata* or *Ascaris* are given the appropriate treatment.

Patients found to be harbouring both ankylostoma and bilharzia worms are treated first for ankylostomiasis, and after these parasites have been expelled, tartar emetic is given. It was found that such patients do not recover well from ankylostoma anæmia if a depressant drug (antimony) is given at the same time.

Bilharzia Division.—At the first attendance the patient is requested to furnish a specimen of urine or stool, according to the symptoms of the case.

Selection of Cases.—Pregnant women, patients obviously unfit, as well as cases of pyuria without living bilharzia ova, are not given tartar emetic.

The Drug used.—Sodium antimony tartrate is the drug generally used. In expert hands it is safe to use a small syringe (2 c.c.) and 6 per cent. solution, i.e., 1 grain in 1 c.c., the injections being made directly into the vein.

Should any antimony solution escape into the tissues, it causes immediate burning pain. If this happens the fluid is aspirated by withdrawal of the piston and hot fomentations applied. Such accidents are rarely met with in the annexes as a result of the experience gained by the medical officers.

Dosage and Course.—For an adult the routine course consists of twelve injections given every alternate day or three times a week, not counting Fridays. For children and women, smaller doses are required, the full dose being 1¼-1½ grains. The dose should be reduced if persistent giddiness or repeated vomiting occurs.

The Use of Emetine.—This drug is used for young children and others when it is found impossible or unwise to attempt an intravenous injection. Emetine can be given subcutaneously, but not more than 1 or 1½ grains should be injected into one site.

Precautions.—(1) Antimony solution must be made in sufficient quantity and sterilized properly. One bottle only should be opened at a time, and should not be kept more than three days. (2) Patients must be inspected after having the injections and any symptoms noted. (3) Patients should be informed that the medicine has a weakening effect and that they must not try to do as much work as usual while undergoing treatment.

Patients must be warned when beginning the course of injections that they must undergo the full treatment for four weeks, otherwise they will not be cured and the disease will return. After having taken eleven injections, the patient's urine is examined and the result recorded. After finishing the course the patient is told to return for re-examination in three months' time. Cases of pyuria after finishing the tartar emetic course may be injected with urotropine.

Laboratory Work.

Examination of Stools.—With a little experience smears can be examined without a cover slip. If it is thought advisable to use a cover slip no pressure should be exercised as it ruptures the bilharzia ova. The type of bilharzia ova found should be entered on the patient's card.

Stools of patients suspected to be suffering from ankylostomiasis are examined by the smear method. If no ova are detected the floatation method must be used.

A small portion of the fæces, the size of a bean, is emulsified in a saturated solution of ordinary salt (NaCl) by shaking vigorously in a stoppered bottle or test-tube. This emulsion is then filtered through a small copper wire sieve (100 meshes to the inch) into a conical Erlenmeyer flask, which is then filled to the brim with saturated salt solution. This is left to stand at least fifteen minutes, during which time the ova will have risen to the surface. The top layer of fluid is removed by dipping under the surface with a wire loop and tapping it off on the centre of a slide. Three or four dips will remove the surface layer. Do not spread out the fluid too much. Examine under the low power of the microscope.

Any ova will be readily seen, as most of the fæcal material has been removed. Remember that the ova are floating on the top of the fluid, which must be focused, and not on the surface of the glass as in ordinary preparations.

Examination of Urine.—With a fine pipette transfer a drop or two of the deposit from a conical urine glass on to a slide. There is no need to use a cover glass. Bilharzia ova are easily detected under a low power of the microscope. When bilharziasis is suspected on clinical grounds but no ova are to be found in an ordinary examination made as above, the urine is centrifuged and the deposit examined. In re-examination the state of the bilharzia ova must be noted. Living ova are clear, with refractile miracidia inside, the organs of which are easily seen. Dead ova are discoloured, shrunk, with a granular content. They do not hatch living miracidia when put into water.

Report on the Work of the Ankylostomiasis and Bilharziasis Annexes during 1920.

The number of patients examined and treated at the annexes during 1920-1923 is 115,036.

Bilharziasis.—An intensive course of tartar emetic injections, 4-5 in number (a total of 8-9 grains), was found to be sufficient to kill the ova if given in the first ten days. The late results of of the cases were unsatisfactory.

Colonial Medical Reports.—No. 179.—Cairo (*continued.*)

Treatment of bilharziasis with emetine, introduced by Diamantis and Erian, was given a trial and was found to be effective. The high cost of emetine militates against its routine use for out-patients; but it is a most useful alternative to use under certain conditions such as: (*a*) For young children or others whose veins are too small or inconspicuous for intravenous injections; (*b*) For patients who exhibit an intolerance for tartar emetic or where an error in technique has resulted in abscess; (*c*) For cases of bilharzial dysentery complicated by a nœbiasis.

The regular course consists of twelve injections containing 22·5 grains of tartar emetic.

Three injections a week on alternate days was the routine course. An analysis of the results shows that both the rapidity of effect and permanent cure are less dependant on the total amount of antimony given than on a regular tri-weekly sequence of injections.

Sodium antimony tartrate was substituted during the year for the potassium salt. On the evidence at hand there does not appear to be much difference in toxicity or effect.

A great many experiments were carried out in the hope of finding a substitute for antimony. Of the metals, copper gave satisfactory results *in vitro*, but though used in fairly large doses on patients (after testing on animals), only a very moderate effect was produced on the ova.

Cases with advanced bilharzial infection with septic urinary apparatus are not relieved by the tartar emetic course. Calcified ova continue to reappear in the urine by ulcerating through the mucous membrane.

It was observed that vomiting and coughing were less marked when sodium antimony tartrate was substituted for the potassium salt.

Nocturnal enuresis in children was noticed to be sometimes an early sign of bilharziasis.

One death occurred as a result of tartar emetic injection. The subject was a girl of fourteen years who had received eight injections without any symptoms. After the ninth she coughed a while and then felt better. She left the tents in a good condition, but in the same afternoon was brought to the hospital in a collapsed condition and died that night.

Compounds of bismuth were tried in bilharziasis treatment with some mild cases, which were cured, the ova being killed. More active infections were much less affected. The drug was not considered as a satisfactory substitute for antimony in this disease.

Two patients developed jaundice after the course of sodium antimony tartrate.

Two patients died after leaving the annexe in apparently good condition.

One girl, after receiving the seventh injection, was seized with convulsions, vomiting and diarrhœa the following day; died six hours after the appearance of these symptoms.

Ankylostomiasis.—As one dose of anthelmintic is beneficial in ridding the patient of a great proportion of the parasites, it was recommended that oil of chenopodium (or thymol) should be administered to every patient suspected of ankylostomiasis at the first visit without waiting to examine his stools beforehand.

Oil of chenopodium was almost the only drug used as a vermicide.

Carbon tetrachloride was under trial. At first it was given in doses of 6 c.c. (adult) and 4 c.c. (children), mixed with an equal dose of castor-oil. It was later given pure in doses of 4 c.c. and 3 c.c. respectively.

ANKYLOSTOMIASIS AND BILHARZIASIS CASES TREATED AT THE GOVERNMENT GENERAL HOSPITALS.

Cases suffering from bilharzia or ankylostoma infection are admitted into the Government General Hospitals, which exist all over Egypt. It is the rule at these hospitals to admit only the severely infected cases. Mild cases are generally treated as out-patients.

It is not safe to conclude that the number of cases admitted into any of these hospitals can be taken as index of the incidence of infection in the neighbourhood because many factors influence the admission of patients into these hospitals. The accommodation available, the railway facilities in the district, the presence of an ankylostomiasis and bilharziasis annexe in the neighbourhood, affect the number of admissions into the general hospitals.

The sudden increase in the number of cases of bilharziasis admitted during 1921 (2,219) over the number admitted during 1920 (655) marks the generalized adoption of tartar emetic treatment in these hospitals.

The number of ankylostomiasis cases treated in the Government General Hospitals during the period of 1914-1921 is 1,724, and of bilharziasis 2,219.

ANKYLOSTOMIASIS AND BILHARZIASIS PROPAGANDA.

In combating ankylostomiasis and bilharziasis in Egypt success cannot be obtained without a hearty co-operation of the people, and this cannot be enlisted unless the inhabitants realize the ravages brought about by these diseases and how infection could be avoided.

In a country where the majority of the inhabitants are illiterate the task of educating them in this direction is not an easy one, as it has to be attempted on a large scale. Lecturing in a simple colloquial language, demonstration with the aid of simple diagrams, and the distribution of leaflets amongst the villagers were attempted with a certain measure of success.

The fact that bilharziasis can now be cured by the newly discovered injections of tartar emetic is familiar to the inhabitants. The main reason preventing the "fellah" (peasant) from ridding himself of the disease is his inability to pay for private treatment, and an annexe established for free treatment anywhere needs no advertising.

From the beginning it is crowded with patients from the surrounding districts. Some patients have sometimes to remain two or three days waiting their turn to be examined and treated. Once the distressing symptoms are abated patients, unfortunately, discontinue treatment, although they are urged to receive the full course.

As the "fellah" is totally ignorant of the means of protection against infection several posters illustrating the danger of promiscuous defæcation were distributed and the danger of polluting the small water streams was especially pointed out.

The habit of defæcating near water courses is common in Egypt and cannot be easily stopped as the Mohammedan religion orders the washing of urethral and anal openings after urination and defæcation. The "fellah" has therefore to go to the nearest collection of water whenever he feels the necessity of micturition or defæcation.

The idea of washing is certainly a hygienic one, but it is only the pollution of the streams which is most objectionable. Such pollution is definitely forbidden by religion as it is dangerous to human health and life and it is absolutely necessary to convince the people of the extreme necessity of stopping it. This washing could be easily substituted by taking a small amount of water in a can or bottle, defæcating on dry ground, washing and burying the excreta. The danger, at least as far as bilharziasis is concerned, will be checked.

II.—Carbon Tetrachloride as an Anthelmintic in Ankylostoma Duodenale Infection.

During 1923 carbon tetrachloride was given a fair trial as an anthelmintic at Qalyûb Ankylostoma Annexe. Fifteen beds were set aside for patients undergoing treatment. After a preliminary trial the drug was given as a routine for outpatients. Careful microscopic examination preceded and followed the treatment and records were kept. The drug was administered to more than 4,000 ankylostomiasis cases. One death, which could not be ascribed to the action of the drug, occurred during the period. The patient on admission was suffering from heart failure, œdema of the legs, and ascites. It is unfortunate that a post-mortem could not be performed.

About one half of the cases treated with the drug returned for re-examination, once or more than once after a lapse of one week or more. It is upon the re-examination of 1,000 of these cases that the following report is based. Various modifications of the mode of treatment and dose given were tried for comparison to arrive at the most efficacious and at the same time the least troublesome method.

Properties of Carbon Tetrachloride.

Carbon tetrachloride (CCl^4) was discovered by Regnault in 1839, who prepared it by the action of chlorine on chloroform in sunshine.

It is a transparent colourless liquid with a pungent aromatic odour. It is a heavy fluid having a specific gravity of 1·63 and is highly volatile; its boiling point is 76·7° C. and is non-inflammable.

Carbon tetrachloride is soluble in alcohol and ether; in water it is soluble to the extent of 1 in 1,250 only. It does not mix with water but forms a distinct layer at the bottom of the vessel containing both.

Carbon tetrachloride dissolves a large number of organic substances, especially those of fatty nature, and it is for the latter reason that it has a wide application in the arts. It has been used as a fire-extinguisher. When prepared on a commercial scale it generally contains, as impurities, small quantities of carbon bisulphide (CS_2) and carbonyl chloride (phosgene $COCl_2$), one of the poisonous gases employed in the Great War. When used for medicinal purposes it should be free from these impurities.

Medical Uses of Carbon Tetrachloride before its Recent Introduction as Anthelmintic.

Carbon tetrachloride was first introduced by Tuson in 1843 as a lotion to be applied externally to cancerous growths. It was given internally in doses of four drops three times a day in gout.

Carbon tetrachloride was used as an anæsthetic, but its general use was given up as a result of a statement by Simpson that it was more depressant to the heart than chloroform.

During 1909, a woman 29 years old, a subject of status lymphaticus, collapsed while being shampooed with carbon tetrachloride and died.

It was used during the war for cleansing the edges of wounds.

During 1920, a girl employed in painting balls with a paint containing carbon tetrachloride suffered from vomiting after meals, headache and anæmia. Frequent inhalation of carbon tetrachloride was reported to cause jaundice.

On the whole, up to a few years ago, carbon tetrachloride was a little-known drug with a conflicting medical evidence as to its therapeutic value.

Introduction of the Drug as an Anthelmintic.

The anthelmintic value of carbon tetrachloride, especially in hookworm infection, was discovered by Maurice C. Hall, Senior Zoologist in the United States Bureau of Animal Industry. Humanity is indebted to the discoverer for this valuable remedy. The drug was first administered to dogs infested with hook-worms in doses of 0·3 c.c. per kilo of body-weight. It was found to be more effective than any other anthelmintic that was hitherto used. It was found to be safe, giving rise to no evident symptoms or post-mortem lesions.

Hall tried the effect of carbon tetrachloride on himself, taking 3 c.c. without any precaution as to food, with no ill-effects.

All the cases recorded were suffering from ankylostomiasis due to *Ankylostma duodenale* infection. No *Necator americanus* infection has yet been recorded in Egypt.

Examination of the Stools.—All stools were prepared by the flotation technique. Concentrated common salt solution was used. By this means detection of cases with mild infection was ensured.

Method of Administration.—Carbon tetrachloride was given in water. As has been mentioned before, the drug is not soluble and does not mix with water. The addition of water increases the volume of the dose and makes it easier to drink. Carbon tetrachloride can be given in gelatine capsules. These must be fresh to ensure their digestion. The method was tried but was given up on account of its expense. The intention was to find out the best method to be used on a large scale in campaigns directed to combat ankylostomiasis. The agricultural class to whom the drug was administered never complained of its taste. It is even thought that the sharp taste of the drug is a recommendation to it. To delicate patients or well-to-do people the drug can be given in capsules.

Dosage.—Carbon tetrachloride was given to adult patients in doses varying from 1 to 10 c.c. With a dose of less than 4 c.c., 50 or more per cent. of the patients revealed ova in their stools when re-examined, seven to fourteen days after treatment. This was the case whether the patient was given a purgative before, after, or both. For this reason the administration of doses less than 4 c.c. was confined only to patients under fifteen years of age, as these caused less nausea and vomiting than bigger doses. On the whole the patients were not inconvenienced by taking such doses.

On the other hand, doses above 7 c.c. for an adult were frequently accompanied by nausea, colicky sensation in the abdomen, burning feeling in the epigastrium, and vomiting. The symptoms were not serious in character and disappeared in twelve hours. As no distinct increase was noticed in the percentage of cures on the administration of such big doses, their use was discontinued early in the work.

Five c.c. was found to be the optimum dose giving the least symptoms and comparatively good results. All cases above 15 years of age were given that dose.

Children were given the drug according to the following table: from 5 to 8 years 2 c.c., from 9 to 11 years 3 c.c., from 12 to 14 years 4 c.c. Debilitated individuals were given comparatively smaller doses. The amounts given to children are a little more than what their age indicates. With anthelmintic the rule of age cannot be strictly adhered to, as the anthelmintic is not intended for absorption into the system, but for its action on the parasites.

Vomiting is the most serious symptom. It sometimes occurs after administering the saline purge and thus it might be caused in some cases by the latter. The incidence of vomiting increased with an increase of the dose administered. It is more frequent in children than in adults.

In delicate individuals carbon tetrachloride causes tenesmus, which may be severe. In cases with hæmorrhoids or severe rectal bilharziasis hæmorrhage may occur, which is alarming to the patient.

Contra-Indication to the use of Carbon Tetrachloride.

Carbon tetrachloride should not be given to cases suffering from evident renal disease.

It is better to avoid giving it to pregnant women till more information on the subject is available.

Cases with severe bilharziasis of the rectum with prolapse should not be given this drug, as well as cases with hæmorrhoids. Constipated individuals should be given a preliminary purge before administration of carbon tetrachloride. Repeated doses are more dangerous than a single large dose.

Inhibition of the Ova-laying Capacity of the Female Hook-worm after Administration of the Anthelmintic.

Following thymol and chenopodium treatment, it was observed that although the stools may be negative for a few days, re-examination after a longer interval gives a positive result. This has been ascribed to the inhibitory action of the drug upon the ova-laying capacity of the female worms left in the intestines. After an interval of ten to fifteen days the female worms begin laying their ova again. Unless this fact is taken into account re-examination during the inhibitory period gives a fallacious result.

It is thus important to find if a similar inhibitory period follows the administration of carbon tetrachloride. Amongst the 1,000 cases recorded in this report, there were 252 cases in whose stools ankylostoma ova were detected upon re-examination.

Aperient Action of Carbon Tetrachloride.

Carbon tetrachloride given without any purgative before or after administration causes looseness of the bowel. This is frequently accompanied with colic. The drug had a distinct aperient action. The number of ankylostoma worms voided was more when a purge was given. It is not clear, however, if the large number of worms expelled is due to a better action of the drug or to retarded elimination of the dead worms.

Carbon tetrachloride has this marked aperient effect in cases with loose stools, as it is indeed the case in most patients suffering from ankylostomiasis. When the drug is given to a constipated person unpleasant symptoms which are sometimes alarming are felt.

The following account is based on a personal experience in addition to two cases observed. In all these cases 5 c.c. of carbon tetrachloride were given with no purge following it. In my case the drug was taken as an experiment, no parasitic infection was present. The other two cases were infected with oxyuris only. The pungent taste of the drug is not very objectionable. It causes a sense of heat in the epigastrium.

Eructations sometimes follow the administration of the drug, causing the breath to smell of carbon tetrachloride. Colicky sensations are felt two or three hours after administration, and these increase in severity. Clammy sweats cover the body and

the extremities are cold. The patient is a little dizzy. If anything is taken by mouth it is vomited. An enema relieves the symptoms and the next morning the subjects feel well again. These symptoms occurred only in cases who were constipated at the time.

It is thus advisable to follow the administration of carbon tetrachloride with a purge as a routine measure.

Value of the Preliminary Purge.—A series of cases was given carbon tetrachloride on the basis of 5 c.c. for an adult, preceded and followed by a saline purge of magnesium sulphate. This was compared with another series in which the preliminary purge was not given. The patients after microscopical diagnosis were kept in hospital. In the evening 30 grammes of magnesium sulphate in water were administered to adult cases; children received the appropriate dose. On the following morning a dose of carbon tetrachloride in about 30 c.c. of water was given to each case, followed in three hours time by another dose of magnesium sulphate. Patients having no preliminary purge, took carbon tetrachloride four hours after the morning meal, i.e., practically on an empty stomach.

It is more advantageous to have a preliminary purge. On the other hand, a preliminary purge necessitates the admission of patients into hospital or at least deferring the treatment to another day. In a campaign or in using this treatment on a large scale this is a distinct disadvantage, as many of the cases will not turn up at the required time or will be unwilling to pass through this tedious process. Moreover, the patient is so weakened by the two consecutive purges as to be unable to work directly after the treatment.

Considering these factors as a whole, the preliminary purge is better omitted when using the drug on a large scale.

Result of Purge Given Before and After Varying Doses of Carbon Tetrachloride.—A trial was made with varying doses of carbon tetrachloride with a purge before and after it. The result was as follows: (1) One adult case was given 2·5 c.c. and was not cured. (2) Eight adult cases were given 4 c.c. each. The result was six cured and two uncured. The percentage of uncured was twenty-five. (3) Thirty-eight cases (adults and children) were given carbon tetrachloride on the basis of 5 c.c. as an adult dose. The percentage of cured was 89·5 and of uncured was 10·5. (4) Fifty-nine cases (all adults) were given 6 c.c. each, with the result that forty-five were cured and fourteen were uncured.

More cases are attacked with vomiting when taking the 6 c.c. dose, which probably accounts for the less favourable result. The conclusion that 5 c.c. adult doses with a saline purge before and after give the best result.

Carbon Tetrachloride followed by Castor-oil.—In this series no preliminary purge was given. Carbon tetrachloride 5 c.c. was administered four hours after the morning meal and followed in three hours by 30 c.c. of castor-oil in the case of adults and a corresponding dose in the case of children.

When any case was found to be still harbouring the ankylostoma worms on re-examination after the first treatment, a second treatment was given. If on re-examination the stools were still positive for ankylostoma ova the treatment was further repeated. Practically all the cases were given on the second and the third occasion a 5 c.c. dose and a saline purge following it whatever might have been the first treatment.

The conclusion is that by repeating the treatment of positive cases till a third treatment is administered, 98·6 per cent. of all the cases will be completely disinfested from the ankylostoma worms.

Most but not all the ankylostoma worms are passed during the first twenty-four hours following carbon tetrachloride treatment, while most of the ascaris are passed during the second twenty-four hours. More female ankylostoma worms than male worms are expelled.

COMPARATIVE RESULT OF TREATMENT BY CARBON TETRACHLORIDE, OLEUM CHENOPODII AND THYMOL.

All the cases were treated as out-patients. No preliminary purge was given, but the drug was followed in three hours by a purge. In the case of oleum chenopodii castor-oil was used; with the other two anthelmintics magnesium sulphate was used.

Dosage.—Oleum chenopodii was given in doses of 1·5 c.c. for an adult, 1 c.c. for children twelve to fourteen years, and ½ c.c. for children of seven years. The drug was given in gelatin capsules. Three courses of such treatment were given. Thymol was given two doses of 2 grammes for an adult, 1½ grammes for children twelve to fourteen years, and ½ gramme for children of eight years. The drug was given in cachets. Three courses of such treatment were given. Carbon tetrachloride was given in doses of 5 c.c. for adults. For children the doses were as stated in the previous table. One course of such treatment was given.

The result was as follows: of 737 patients treated with carbon tetrachloride 564 were cured; of 118 patients treated with oleum chenopodii 59 were cured; of 53 patients treated with thymol 20 were cured.

It is evident from this that carbon tetrachloride under the conditions detailed above is by far the best drug of the three and the cheapest to use.

EFFECT OF CARBON TETRACHLORIDE IN INTESTINAL PARASITIC INFECTIONS OTHER THAN ANKYLOSTOMIASIS.

Oxyuris Infection.—Large numbers of *Oxyuris vermicularis* worms are expelled as a result of the administration of carbon tetrachloride. In many cases several thousands of the parasites can be found when counting the ankylostoma worms expelled. The drug is more effective in this infection than any other known drug, but it does not afford a complete cure. Many cases after the lapse of three to four weeks are found to be infected in a mild degree. Oxyuris infection is one of the most difficult to cure.

Colonial Medical Reports.—No. 179.—Cairo (*continued.*)

Ascaris Infection.—Sixty-eight cases which harboured both ankylostoma and ascaris worms were given carbon tetrachloride on the basis of 5 c.c. adult dose followed by a purge of magnesium sulphate. The re-examintion showed that forty-nine were cured and nineteen were still harbouring the parasite. Carbon tetrachloride is inferior to oleum chenopodii as an anthelmintic in ascariasis.

Trichostrongylus Infection.—Seventeen cases harbouring this parasite in addition to ankylostomiasis were given carbon tetrachloride according to the above routine. Only one case was found on re-examination to be free from trichostrongylus infection.

Hymenolepis nana Infection.—Six cases harbouring *Hymenolepsis nana* were given carbon tetrachloride in 5 c.c. doses. None of them was cured.

Lamblia Infection.—Carbon tetrachloride was administered to three cases who had been suffering for a long time from dysentery characterized by irregular attacks with intervals of no complaints. Microscopical examination of the stools revealed the presence of *Lamblia intestinalis* only. The three cases were relieved of their dysentery infection after taking carbon tetrachloride, and examination of the stools was negative for *Lamblia intestinalis* and its cysts. Six months have passed since the treatment and the cases are enjoying good health. One of them, however, had dysenteric symptoms for one day, but these have disappeared without treatment. The stools were examined immediately after this attack, but no lamblia or cysts were discovered. So far the results of treatment of this resistant protozoal infection are encouraging.

SUMMARY.

Carbon tetrachloride is a valuable and safe anthelmintic in ankylostomiasis. It is effective to some extent in ascariasis and oxyuriasis. It is also a valuable remedy in lamblia infection.

The optimum dose for cases with *Ankylostoma duodenale* infection is 5 c.c. for an adult to be followed by a saline purge. The drug is more effective if preceded by a saline purge in addition. It is slightly aperient and is little absorbed in the intestine and is excreted in the stools.

No confinement to bed after administration is necessary.

Repeated doses of the drug are to be avoided except after a long interval.

The drug should not be given in cases with renal diseases; severe intestinal bilharziasis, hæmorrhoids, and hepatic disturbances.

Only pure carbon tetrachloride should be used; its freedom from poisonous impurities should be guarded against by previous administration to experimental animals.

Carbon tetrachloride is much cheaper than thymol or oleum chenopodii. It is particularly suitable for anti-ankylostomiasis campaigns.

III.—The Control of Bilharziasis in Egypt.

The Incidence of Infection.—Bilharziasis is a widely spread disease amongst the population of Egypt.

Although there is proof of the existence of bilharzia infection in mummies of 1250-1000 B.C., reliable records as to the incidence of infection in Egypt were collected during the latter half of the last century only.

The infection with bilharziasis is probably increasing in Egypt. This may be accounted for by the continuous construction of small irrigation canals and drains throughout the country. These are favourable places to the snail-carriers of bilharzia.

Infection with *Schistosoma hæmatobium* is probably homogeneous throughout the country, whilst infection with *Shistosoma mansoni* is practically localized to the north of the Delta. Other localities have still to be investigated before this conclusion can be accepted as final.

THE SCIENTIFIC BASIS OF MEANS OF CONTROL OF BILHARZIASIS.

Before the discovery of the life history of the schistosome parasites, the means of infection with the disease was not known and consequently prevention was merely guess work. It was suspected at an early period that water was the source of infection, but no serious efforts were attempted at prevention.

When the life history of the Egyptian human schistosome was discovered by Leiper, 1915-1918, it served as a sure basis for preventive measures.

Three species of genus *Bullinus* act as the intermediate hosts of *Schistosoma hæmatobium* (Bilharz, 1852); *Bullinus contortus* Michaud, 1829, *B. dybowsky* Fischer, 1891, and *B. innesi* Bourguignat.

The life cycle of *S. mansoni* Sambon, 1907, is similar to that of *S. hæmatobium*, substituting *Planorbis boissyi* Potiez and Michaud, 1388, for snails of the genus *Bullinus*.

If the life cycle could be broken at any of its stages, the parasites would not develop and the disease will be controlled. If the break in the cycle is a complete one the disease will be abolished, but if it is not thorough the incidence of infection will be decreased to a certain extent.

The possibilities of breaking the cycle can be discussed under the following headings: (*i*) Protection of man from being infected with the cercariæ; (*ii*) Guarding streams against pollution; (*iii*) Killing the miracidia; (*iv*) Extermination of the molluscan intermediary host.

Bilharziasis in Egypt is a problem of grave national importance. Statistics show that about 75 per cent. of the inhabitants are infected. The disease affecting children in early life arrests to a certain extent their bodily and mental development, whilst amongst adults it deteriorates the value of manual labour. It causes a good deal of suffering

and claims a big toll of mortality, which has been estimated by Griesinger at 25 per cent. of all deaths, and, according to Ferguson, at 8 per cent. In addition, it predisposes to infection with other diseases and diminishes the normal resisting power of the body.

The problem of combating this disease is both difficult and complicated, in addition to its enormous magnitude. The difficulties, however, are not unsurmountable.

A campaign proposed to combat this disease ought to be so planned as to attack the disease from different aspects at the same time. Each measure, although by itself might be inefficient, yet it will ensure to a certain extent the success of other measures. The following are the promising points of attack: (1) Prevention of the pollution of irrigation channels by (*a*) Erection of house and village latrines and inducing the inhabitants to use them; (*b*) Propaganda amongst inhabitants illustrating the dangers of stream pollution (*c*) If possible enlisting the co-operation of religious authorities in condemning stream pollution.

(2) Guarding water used for drinking and household use by: (*a*) Localizing the spots where villages can draw their water. These must be from the river or canal where no snails are present; (*b*) Protecting that locality from pollution; (*c*) Advising the inhabitants to store their water on the premises for forty-eight hours before use.

(3) Attempt at exterminating the mollusca by: (*a*) Utilizing the summer rotation of irrigation in Egypt causing dryness of the small irrigation channels; (*b*) Treating the small amount of water left in these channels with copper sulphate solution; (*c*) Guarding the intake of these channels against the introduction of snails by proper sieves if possible.

(4) Treatment of infected individuals on a large scale.

At present the attempt at the extermination of snails appears the most promising. The system of irrigation in Egypt controls in a unique manner the water supplied to any particular area. The co-operation of the Irrigation Department with the Department of Public Health in such a project is fundamental.

IV.—Parasitic Diseases at Saft el Enab Village.

Intestinal and Urinary Parasitic Worm Infection in an Egyptian Village.

The investigations detailed in this report were carried out at Saft el Enab, a village near Damanhûr, in the Delta. There was an unexplained high incidence of mortality in the village during 1922. The opportunity of investigations being undertaken at the village was utilized to arrive at the extent of parasitic worm infection in a fair sample of the population. This included representatives of all age periods of both sexes, as well as the different social classes met with in such a village.

Four registered midwives were employed in visiting houses and collecting samples from women. It was evident that only the poor women who were mostly field workers submitted specimens easily. The midwives could not influence women from better class families to do the same.

With males, conditions were different. They were easily influenced by argument and demonstration of the different phases of the life history of some parasites and the havoc brought about by them. Microscopical demonstration of living specimens always appealed to them. In spite of their lack of education, these people were very sensible and inquisitive, discussing what they see when they are treated in a gentle manner.

Method of Examination.— Urine was centrifugalized and the deposit was pipetted into a watch glass and examined with a low power of the microscope for *S. hæmatobium* eggs. It was found that sedimentation in a conical urine glass and examining the sediment was not sufficiently accurate to show cases of mild infection.

A smear of the fæces on a slide 3 × 1 inches was examined. In addition about 1 gr. of the stool was emulsified, strained in a wire sieve and concentrated sodium chloride solution added to it (floatation method). After fifteen to twenty minutes the surface film was lifted by means of a platinum loop and examined for eggs.

In most cases the hæmoglobin index was tested by the Talquist hæmoglobinometer; blood-films were made for differential counts and the weight and height of the person were recorded as index to his state of nutrition.

Treatment was administered to those who voluntarily applied for it, which, after a few demonstrations of *Ascaris* and *Tænia saginata* expelled, included most of those examined.

Of the 274 persons whose urine and fæces were examined, 262 were found to be infected with one or more parasites, and only twelve individuals were free from any evidence of infection as could be detected by the methods employed. This gives an incidence of parasitic worm infection in the whole population of at least 95·6 per cent., and only 4·4 per cent. of the population are presumably free.

Species met with.—Ova of nine species of helminth parasites and the larvæ of one were met with during the investigation. These were:

Trematodes.—(1) *Schistosoma hæmatobium* (Bilharz, 1852) Weinland, 1858. (2) *S. mansoni* (Sambon, 1907) Leiper, 1918.

Cestodes.—(3) *Tænia saginata*, Goez, 1782. (4) *Hymenolepis nana*, von Siebold, 1852.

Nematodes. —(5) *Ascaris lumbricoides*, Linnæus, 1758. (6) *Ankylostoma duodenale* (Dubini, 1843) Creplin, 1854. (7) *Strongyloides stercoralis* (Bavay, 1876) Stiles and Hassal, 1902. (8) *Trichocephalus trichiurus* (Linnæus, 1771) R. Blanchard, 1895. (9) *Eterobius vermicularis* (Linnæus, 1758) Leach, 1853. (10) *Trichostrongylus sp.*

Bilharzia Infection.

Snails in the Irrigation Canals.

The canals were all surveyed for their molluscan fauna. The following species were found: 1—*Bullinus contortus*, Michaud, 1928. 2—*B. dybowski*, Fischer, 1891. 3—*B.* (*Pyrgophysa*) *forskali*, Ehrenberg, 1831. 4—*Cleopatra bulimoides*, Olivier, 1804. 5—*Lanistes bolteni*, Chemnitz, 1786. 6—*Planorbis boissyi*, Potiez and Michaud, 1838. 7—*P. mareoticus*, Innes, 1884. 8—*Vivipara unicolor*, Olivier, 1801.

Of these species, Nos. 1 and 2 interest us as carriers of *Schistosoma hæmatobium*, and Nos. 6 and 7 as carriers of *S. mansoni*. The species of *Planorbis* were fairly common all along the terminal branches of the irrigation canals. Where these canals have been cleaned lately the shells were quite evident in the dry mud on either side of the channel, attracting attention by their white colour. *P. boissyi* was by far the commonest species met with.

Only eight specimens of *P. mareoticus* were collected. *Bullinus* was fairly common in these canals, although in less numbers than *Planorbis*.

S. hæmatobium infection was more widespread than infection with *S. mansoni*.

All classes of the community and both sexes were infected with *S. hæmatobium* to practically the same extent. The infection was very mild. None complained of the disease. They had very mild bladder symptoms which they did not trouble about. On the other hand, the field workers were heavily infected with *S. mansoni* and were in many cases incapacitated by it. The universal complaint was diarrhœa with blood. Some of the children and females who occasionally visit the fields and do some work there, were infected in a mild degree with *S. mansoni*, but they seldom complained of any symptoms, the ova found in the stool being in most cases the only clue to their infection.

Schistosoma hæmatobium.

Infection with this parasite is by far the most prevalent at Saft el Enab. No less than 73 per cent. of the 318 individuals whose urine was examined were found to be infected. The infection was common in all classes of the community and in both sexes. Specimens of urine were centrifugalized, if direct examination of the deposit proved negative to *S. hæmatobium* ova. High speed centrifugalization destroys the ova and liberates the miracidia. 300-400 revolutions per minute for one or two minutes is all that is required.

In most of the 232 positive cases of *S. hæmatobium* infection, the characteristic ova were met with in the urine.

When tartar emetic is administered to cases with both *S. hæmatobium* and *mansoni infection*, the ova disappear from the urine long before any change could be noticed on *S. mansoni* ova in the stools.

In no case was *S. mansoni* ova met with in the urine.

Schistosoma mansoni.

Infection with *S. mansoni* is limited to the intestinal tract, particularly to the large intestine.

The ova of this parasite are detected in smear preparations of the stools mixed with normal saline or water and examined with a low power of the microscope.

The floatation method devised for detecting *Ankylostoma* ova destroys the ova of *S. mansoni* owing to the high osmotic pressure of the solution causing the ova of the latter parasite to collapse and thus rupture.

The ova of parasites living in the small intestine, i.e., *Ankylostoma*, *Ascaris*, &c., are thoroughly mixed with the liquid contents of the bowel and can be looked for with safety in any portion of the stool.

The condition is different from *S. mansoni*, the ova are voided through the mucus membrane of the large intestine, particularly that of the sigmoid and rectum. The fæcal contents of the sigmoid portion of the gut under normal conditions are solid or semi-solid in consistence. The rectum under normal conditions is empty.

The ova are found smeared on the surface of the fæces in a layer of mucous that surrounds the fæcal mass and particularly in the last portion of the stool mixed with blood and mucus if present.

In cases where there is diarrhœa the eggs are mixed with the motion to a certain extent. In such cases if blood is present, it is in the portion containing it that most of the ova are found.

It is extremely important where *S. mansoni* infection is suspected to have the whole of the stool sent for examination and the proper portion selected for making the smears. Instructing the patient to bring a piece of the stool in a small glass tube will certainly lead to negative findings where proper examination would have revealed infection with this parasite.

In view of the difficulty in finding *S. mansoni* ova in the stool, especially when one smear is examined, it is almost certain that the reported incidence with this parasite underestimates the true condition of affairs. *S. hæmatobium* infection of the urinary tract is easily detected, and thus the reported results probably reveal the actual condition as regards the prevalence of that infection.

Tænia saginata.

Ova or segments of *Tænia saginata* were met with in the fæces of three individuals only. They were all males. It is interesting to note that two were brothers and both were butchers by trade. On inquiry as to ingestion of uncooked meat it was revealed that both brothers used to eat a little of the raw peri-nephritic fat so as to entice the customers as to the good quality of their meat.

Four c.c. of *Filix mas* extract were administered after a preliminary twenty-four hours' fasting and a saline purge. Another purge followed three hours later. The older brother (24 years old) passed one

T. saginata coiled in one lump complete with head and very few detached mature segments. The whole worm measured 425 cm. when it was in a fresh condition. The younger brother (18 years old) passed two *T. saginata* worms. They came out in a long string and took more than two hours in passing. It was a very tedious process. In spite of instructions not to pull them out, forcible traction was evidently used, with the result that the string of strobila was broken. Neither head was found, although pieces measuring more than 2 metres of both worms were passed comprising the very small immature segments 1-2 cm. from the neck region. These unmistakably belonged to two different worms.

The older brother harboured in addition *S. hæmatobium* and *mansoni*. His hæmoglobin index was 85 per cent. The younger brother harboured *S. hæmatobium* and *Ascaris* in addition to the *T. saginata*.

The third case was a carpenter 28 years old. There was no history of his eating raw meat. He harboured in addition *S. hæmatobium* and *Ascaris*.

It is to be expected that *T. saginata* infection will be found to be comparatively common in Egyptian villages. The meat is not inspected and thus there is no means of condemning infected carcases before consumption.

Hymenolepis nana.

This parasite of man is identical morphologically with *Hymenolepis fraterna*, a cestode which is a common parasite of rats and mice. It is, however, distinct from it biologically, each species being peculiar to its host only.

There is a good deal of evidence to show that the ova of this parasite are seldom recognized by practitioners in Egypt, and so it has so far attracted little or no attraction.

Fives cases of *Hymenolepis* infection were met with. Three were males under ten years of age and two were females both between twenty and thirty years old.

It was not possible to treat these cases and secure specimens of the parasite and study their pathogenic effect on the host.

The eggs, which were quite distinctive, float in concentrated saline solutions and thus could be detected by the floatation method.

Very little is known about the pathogenic action of *Hymenolepis* infection. Nervous symptoms and derangement of digestion are ascribed to it. It is commonly a parasite of children, although it is sometimes found in adults.

Ascaris lumbricoides.

Next to *Schistosoma hæmatobium*, *Ascariasis* is the most widespread parasitic infection met with at Saft el Enab. No less than 64 per cent. of the inhabitants showed evidence of its presence. In most of the 210 positive cases the ordinary fertilized ova of *Ascaris* were seen. In seven cases, however, unfertilized ova only were found. These are irregular in shape, rather elongated and bear the characteristic knobs seen on the normal eggs, which are frequently stained yellow or brown with bile.

Unfertilized eggs signify the absence of male worms from the intestine. This is frequently the case when the host harbours a single worm or at most two. Two of the seven cases showing unfertilized eggs were treated with santonin. One passed a single female and the other passed two females.

It is peculiar that infection with a single *Ascaris* is frequently accompanied with serious nervous symptoms, especially in children and young adults.

In one case both fertilized and unfertilized *Ascaris* eggs were seen. Such a coincidence could not be easily explained unless we suppose that one female got isolated from the rest of males. Whatever may be the right explanation the fact is worth recording.

Ova of *Ascaris* were sometimes met with having a smooth outline and no bosses on the surface. The ovum is easily mistaken by the uninitiated for that of *Ankylostoma duodenale*. Its thick shell and unsegmented content ought to be sufficient to indicate its true nature.

Judging from the approximate number of ova met with in one slide the infection was found to be severest amongst children. In one case a male child of seven years expelled as a result of treatment with one dose (0·20 gm. santonin) 81 *Ascaris* and he was still passing worms. The number of worms passed by this child caused an excitement amongst the inhabitants, who applied for examination in large numbers as a result of this practical demonstration.

Ankylostoma duodenale.

Amongst 331 individuals examined, evidence of *Ankylostoma* infection was found in 55 cases.

In all cases a smear was first examined and then the floatation method was applied. The latter method was very successful, especially as the *Ankylostoma* infection in most cases was very mild and few eggs only could be seen. It was found necessary to leave specimens in salt solution for fifteen to twenty minutes before examining the surface. Otherwise, the results could not be relied upon.

Clinically severe cases of ankylostomiasis were very rarely met with.

The following method for examination for *Ankylostoma* larvæ was found to be the most effective. About 40 gm. of fæces are taken and mixed with 2 c.c. of water to form a thin paste in the bottom of a large Petri dish 17 cm. in diameter. The cover of the Petri dish is lined with a circular disc of filter paper which is always kept moist. It is found necessary to moisten that filter paper once every twenty-four hours. The preparation is always kept closed. In Egypt it is sufficient to keep the Petri dishes at room temperature. In colder climates it it best to keep it in an incubator at temperature ranging from 25° C. to 30° C.

Colonial Medical Reports.—No. 179.—Cairo (*continued*)

It is found that the mature larvæ migrate from the fæcal mass upwards to the moist filter paper in the cover. They can be collected by swelling the cover with a few c.c. of warm water and pouring it into a proper receptacle when it is found to contain the larvæ free from the fæcal matter.

The process of collecting larvæ can be repeated every day for several days. From one such preparation as much as 40,000 larvæ were collected in four days.

It was found that success depends upon the reaction of the medium, the slightest acidity continuing over several days kills the larvæ. Excess of alkalinity has the same effect. The best medium is neutral or slightly alkaline.

In cultures kept at room temperature ranging from 33° C. to 37° C. mature larvæ were collected on the third day. Details of observations on the development of larvæ will be published later.

Enterobius vermicularis.

The eggs of this parasite were met with in the stools of five cases only. This does not give any idea as to the real incidence of infection with this parasite. The eggs are seen in the stools only in rare circumstances when the adult female is ruptured, due to injury or manipulation of the specimen.

In connection with another investigation at Qualyûb, *Enterobius vermicularis* eggs were seldom seen in the stools, but on administration of anthelmintics for *Ankylostoma*, adult *E. vermicularis* were met with in a high percentage of the cases.

It is probable that the infection is widespread, although it cannot be gauged by the examination of the stools for eggs. That the presence of eggs in the stools is in most cases the result of rupture of the adult females is confirmed by the common experience that eggs, whenever met with are found in large numbers.

Trichostrongylus sp.

The egg of *Trichostrongylus* as seen in the fresh stool has a thin transparent shell and contains a morula. It is rather longer and narrower than the *Ankylostoma* egg, for which it is commonly mistaken. This egg was met with in eight cases. It is easily detected by the flotation method as applied to *Ankylostoma*. There are three species of *Trichostrongylus* that are reported from man in Egypt. All three species inhabit also the intestine of sheep and camels in Egypt.

These species are: (1) *Trichostrongylus instabilis* (Railliet, 1893), Looss, 1895. (2) *T. probolurus* (Railliet, 1896), Looss, 1905. (3) *T. vitrinus*, Looss, 1905.

It is practically impossible to distinguish between these various species from the ova which are closely identical. It is only by adult specimens that the species can be determined. The pathogenesis of these parasites is not known.

Intestinal Bilharziasis causing an Epidemic-like Increase of Mortality in an Egyptian Village.

History of Outbreak.

Towards the end of August, 1922, the Medical Officer of Markaz Kôm Hamâda noticed that for some time past there was a steady increase in the number of deaths at Saft el Enab.

A cordon was established at the village on August 26, and all sick people were compulsorily isolated. From the beginning there was no uniformity in the symptoms or signs manifested by the patients. The medical officers in touch with the cases were not in agreement as to the cause of the outbreak or as to the diagnosis of the malady.

Mixed bacillary dysentery was the diagnosis tentatively arrived at. Antidysenteric serum was given a trial, but its results were unfavourable. Better results followed the use of emetine, which was tried empirically, although amœbæ or cysts were not found in the stools of patients to any extent.

We are in a position now to understand why emetine gave better results. It benefited the bilharzia, which was the main cause. In addition, as the disease ended in some cases fatally there was an opportunity for a careful post-mortem to be carried out.

The number of cases received at the hospital was twelve, of whom five died. None of these cases had any rise of temperature in hospital except for an occasional day following intravenous injection of tartar emetic. All of them were emaciated and weak although not confined to bed. They had suffered from diarrhœa with blood for a long time in the past with periods of improvement and subsequent relapses. Many of these cases lost one or more adult male relatives by the same disease. Their women relatives were healthy.

The freedom of women and children from this disease was one of the most interesting and peculiar features of the outbreak. On instructing the midwives to collect specimens of urine and fæces from women in the village, we were told with evident chagrin that the women were flourishing and healthy and it was only the poor men who were affected.

One thing was common in the post-mortem findings of all cases examined and that was bilharziasis of the intestine in varying degrees of severity. It was frequently associated with peripotal cirrhosis of the liver.

It is evident from the clinical, laboratory and post-mortem findings that the majority of the cases seen at Saft el Enab were suffering from severe bilharziasis of the intestinal tract. The severity of the infection can be gleaned from the fact that *Schistosoma mansoni* ova often in large numbers were easily demonstrated in the small amount of fæces sent on cotton swabs for bacteriological examination. Nine out of twelve swabs were found to contain ova.

Although clinical and post-mortem examination pointed to intestinal bilharziasis as the main cause of the disease and mortality at Saft el Enab, the outbreak was labelled bacillary dysentery. Bilharzia is so common in Egypt that it is held in contempt by the medical profession. It is not thought to be a sufficient cause for death. This is borne out by the numbers of death returns labelled as due to bilharziasis or ankylostomiasis in the whole country.

Intestinal bilharziasis in fairly advanced condition is a serious disease. With the large intestine studded with large fleshy papillomata that are liable to slough and leave ulceration, the raw surfaces are constantly irritated by the faecal contents of the bowel and exposed to their multifarious bacterial contents. They are occasionally parasitized by the *Entamœba histolytica* of dysentery. Cirrhosis of the liver (periportal type) is frequently present in advanced cases.

The inevitable diarrhœa caused by irritation of the bowel is chronic, lasting for months. This is generally accompanied by a certain degree of toxæmia having in most cases a fatal termination. The cause of death is labelled in many cases dysentery, heart failure, cirrhosis, &c., and the primary cause is not mentioned.

Why the disease assumed an epidemic-like course at Saft el Enab is not definitely known, but two theories are offered: (*a*) A super-imposed heavy infection with intestinal bilharziasis occurred during the summer of 1922. The channels around Saft el Enab are a suitable habitat for the snails; or (*b*) A mild bacterial infection broke out, i.e., bacillary dysentery to which the adult males previously debilitated by bilharziasis succumbed while the other members of the community escaped. The series of end canals surrounding Saft el Enab sufficiently explained the high incidence and severity of intestinal bilharzial infection.

The main feature of the outbreak at Saft el Enab is the excessive mortality of adult males. Similar conditions have been prevailing at this and other villages during the previous years. The only difference was that these deaths were spread throughout the year and thus had attracted no attention. In some villages the number of deaths in adults was as much as five times the expected number of deaths.

Recommendations carried out at Saft el Enab.

At the time during which the investigations were carried out the following routine was gradually evolved: (1) Tartar emetic to be administered intravenously to all cases of bilharzial infection. (2) Ankylostomiasis cases were treated with thymol, and ascariasis and santonin. (3) Segregation of the sick was stopped. All patients were allowed to proceed to their houses.

They were instructed to visit the cordon at the proper time for treatment. (4) All debilitated individuals were given free meals at the cordon three times a day. The following proposals were submitted to the Irrigation Authorities with a view to modifying the course of the canals round Saft el Enab to make them less suitable as a habitat for the snails. (1) The canal passing through the village to be abolished. (2) Reconstruction of the irrigation canals to ensure a continuously flowing water with no dead ends. (3) To establish such a canal at a considerable distance from the village buildings, to lessen the chance of young children becoming infected and to the people from using it for the disposal of refuse. (4) Encouraging the people to use "sakias" (water wheel) instead of the universal use of the "tambour."

(5) The extension of Kalashan drain which ends within two kilometres from the village so that it may help in draining the surrounding marshes. It will also be useful in another way. During "taharik" when most canals are dry, the canals at Saft el Enab contain a certain amount of water which preserves the life of the snails. A drain in the locality will help in drying up these canals and thus destroying their snail inhabitants.

Bilharziasis of the urinary tract is widely spread amongst the inhabitants of Nag Hamadi district. About 75 per cent. of the total inhabitants are infected. Ankylostomiasis infection is present to a lesser extent. About 44 per cent. of the inhabitants are infected.

The widespread bilharzia infection is significant as it has been stated by authorities that bilharzia infection is not widespread in Upper Egypt. This was thought to be principally due to the absence of irrigation schemes which necessitate the presence of canals and drains, which are the principal habitat of the snail carriers of bilharzia.

Such irrigation channels are found around Nag Hamadi district.

Most of these canals are the result of private enterprise on the part of His Highness Prince Youssef Kamal and a European company established in the neighbourhood. It might be safely concluded that these irrigation schemes caused the spread of bilharzia infection amongst the epople.

It is in the interest of those large proprietors that the inhabitants of Nag Hamadi district should be freed of their infection as they would become better fitted to carry on the agricultural work for the landowners. At present most of the agricultural class are depleted by this chronic disease, which is often contracted during childhood, of a good share of their energy. The landowners are obliged to employ them weak as they are at the standard market value.

VI.—A New Trematode Parasite of the Rat, Echinostoma Ægyptiaca nov. sp.

During the summer of 1923 a rat, *R. rattus*, was caught in the Public Health Laboratories, Cairo. The animal was killed and dissected for evidence of parasitic infection. Blood-films contained *Trypanosoma lewisi* in large numbers. In the small intestine seven *Trematode* parasites were found.

The *Trematodes* were living and the microscopic examination revealed that they were members of

the family Echinostomidæ. All the parasites were adults with the uterus full of ova. The ova were detected in the fæces of the animal.

Hitherto only one species of this family, *Echinostoma spiculator*, was described from the rat by Dujardin in 1845. We are indebted to Professor R. T. Leiper, of the London School of Tropical Medicine for supplying us with the account given by Dujardin on *E. spiculator*. On careful study of the scanty literature available of this parasite we came to the conclusion that the *Echinostoma* met with in Cairo is specifically different from Dujardin's species. We propose to name it *E. egyptica*.

Description of the Parasites.

Fresh specimens are pinkish in colour. Specimens fixed in Schaudinn are dirty white. Preserved specimens are about 6·6 mm. in length and 0·8 mm. in breadth. Fresh specimens vary in length according to their condition of contraction or relaxation. The parasite is elongated, ribbon-like with a tapering cephalic end and a rounded caudal extremity. The cephalic end is triangular in shape, its apex contains the oral sucker with the mouth opening. The body is flattened dorso-ventrally.

The cephalic extremity is surrounded by a double row of 43 thick pointed spines. The cephalic third of the body is closely beset with small spines over the whole surface. Caudal to the ventral sucker, the cuticular spines become fewer and far between, caudal to the testes they apparently cease altogether. The cephalic pole is triangular in shape and is separated from the rest of the body by a distinct groove. It is surrounded peripherally by a double row of spines, which encircles the head except at the middle line ventrally. They are forty-three in number. On either side of the middle line ventrally there is a group of five spines, i.e., close to one another. Each spine is 50 microns in length. The spines are crowded laterally but are wider apart dorsally. The ventral sucker is placed in the mid-ventral line closer to the cephalic line than to the caudal end. It is one millimetre distant from the cephalic extremity. The sucker is large in comparison with the size of the *Echinostoma*. It is 0·5 millimetre in diameter. The oral aperture opens at the pointed cephalic end. It is 0·10 millimetre in length, being little longer than it is broad. The opening leads into a thin elongated œsophagus surrounded with a thick globular muscular bulb. The intestinal cæca branch from the œsophagus 0·7 millimetre from the cephalic extremity. The intestinal cæca are thin and curving round the acetabulum, pursue a direct course caudally till they end blindly close to one another at the posterior end. Each intestinal cæcum is a little shorter than the length of the parasite and lies close and parallel to the lateral border of the worm. The cæca are hidden from view in most of their course by the profuse vitelline glands.

All the genital organs with the exception of the vitelline glands lie between the two testinal cæca.

Male Organs.—The two large testes lie caudad of the ovary one cephalad of the other, close to the caudal end of the worm. The caudal testis lies 1·5 millimetres from the posterior end. Each testis is elongated and slightly lobed. The anterior testis is 0·78 millimetre in length and 0·46 millimetre in breadth. The posterior testis is 0·9 millimetre in length and 0·37 millimetre in breadth. The space between the testis is 7 microns. The cause of the vast difference could not be traced. The cirrus sac is large and elongated, being 0·5 millimetre in length. It opens into the genital pore close to the bifurcation of the intestinal cæca cephalad of the acetabulum.

Female Organs.—The ovary lies in the mid-ventral line practically midway between the cephalic and caudal ends. It is pre-testicular. The ovary is rounded in shape, being 0·3 millimetre in diameter and 0·3 millimetre cephalad of the anterior testis. The fine ovarian duct begins at its caudal extremity and is surrounded by the large and irregularly shaped shell gland which lies close to the ovary. To the right of the shell gland lies the large receptaculum seminis while caudal to it, the two vitelline ducts meet and join the ovarian duct.

The vitelline glands are numerous and extend over more than two-thirds of the total length of the body surrounding and obscuring from view the intestinal cæca. The glands on either side approach caudad of the posterior testis extending as far as the mid-ventral line.

The uterus is slightly convoluted and lies mostly in the mid-ventral plane between the two intestinal cæca cephalad of the ovary. It is packed with ova. The termination of the uterine canal passes dorsal of the acetabulum ending in the vagina which opens into the common genital pore in conjunction with the male organs.

Ova.—The ova are deep brown in colour and oval in shape. They are operculated. The ovum is 100 microns in length and 57 microns in breadth. Ova contain collections of cells with a large amount of yolk. The genital opening lies in the mid-ventral line anterior to the acetabulum and posterior to the junction of the intestinal cæca. The genital opening is not raised above the surface of the body.

Excretory Organs.—The excretory pore lies at the caudal extremity. The excretory vesicle is hidden by the vitelline glands.

Host.—The common house rat (*R. rattus*).

Habitat.—Small intestine.

Locality.—Cairo, Egypt.—The type species has been deposited in the Parasitological Museum of the Public Health Laboratories, Cairo.

VII.—Complement Fixation Reaction in Bilharziasis by the use of Fasciola Hepatica Extract as an Antigen.

The present investigation was undertaken before the writer was aware that some serologists in Europe have already attempted the serum diagnosis of bilharziasis by using *Fasciola hepatica* extract as an antigen.

The idea was that as liver fluke infection and bilharziasis were two diseases caused by two parasites of the same class, a serological group reaction might be present, similar to that found in bacterial infections.

Fairley's complement fixation for bilharziasis requires an antigen prepared from cercaria infected snail livers. Such material is not always available and cannot moreover be easily prepared. Liver flukes, on the other hand, are met with in every slaughter-house and exist in such large quantities to allow of easy preparation.

Hoppli appears to be the first to have recorded results showing that he obtained positive complement fixation in infections of both *Schistosoma mansoni* and *S. boris*. He employed alcoholic extracts of adult *F. hepatica* as an antigen.

Bettencourt and Borges, repeating Hoppli's experiments, were unable to confirm his results with cases of *S. hæmatobium*. Out of twenty-three bilharzia cases, seventeen gave negative results and six only were positive.

Le Bas found that alcoholic extracts of *F. hepatica* were capable of fixing complement in a greater degree with sera from persons infected with *Schistosoma* than with normal sera. The fixation with the sera investigated was found to be weak and of little diagnostic value.

Recently Fairley and Williams showed, in corroboration with other former co-workers, that in hepatica distosomiasis of sheep, specific antibodies were present in the blood of the infected animals, and that extracts of *F. hepatica* possess true antigenic properties. The authors recommend the complement fixation test for the diagnosis of fluke infection in man.

Preparation of the Antigen.

(1) *Alcoholic Extract.*—Fresh flukes obtained from the bile ducts of infected sheep were thoroughly washed with normal saline solution to get rid of the bile. 20 grm. of the washed flukes were well ground with sand in a mortar. 200 c.c. of alcohol (95 per cent.) were added to the resulting paste, and the whole was put in a sterile bottle. The bottle was left for seven days in the incubator at 37° C., being well shaken daily. The extract was then filtered through filter paper.

(2) *Watery Extract.*—This extract was prepared in the same way as the previous one, with the exception that half per cent. carbolic saline was used instead of alcohol, and the incubation was for twenty-four hours only.

The antigens were then standardized for the estimation of their anti-complementary dose. One-third of this dose was taken as an antigen dose for the complement fixation test.

Technique of the Complement Fixation Test.

0·5 c.c. of a 1 : 4 dilution of the patient's serum, 0·5 c.c. of antigen and 0·5 c.c. of fresh serum of guinea-pig (diluted 1 : 10) were placed in a water bath at 37° C. for 40 minutes. To this, 0·5 c.c. of a 5 per cent. emulsion of sheep's red blood-corpuscles and 0·5 c.c. amboceptor (4 m.h.d.) were added. After remaining for 20 minutes in the water bath, the result was read.

The investigations here recorded were made on 79 cases of *Bilharzia hæmatobium* infection in which ova were present in the urine, and on 32 negative cases in which no ova were found. The alcoholic extract was used in 45 of the positive cases and in 20 of the negative cases.

The carbolic saline extract was used in 34 of the positive cases and in 12 of the negative cases.

The Wassermann reaction was done with all sera, using the alcoholic extract. Cases showing positive Wassermann reaction were eliminated.

The results of complement fixation in bilharziasis cases using the alcoholic extract show that the alcoholic fluke extract is capable of binding complement with 71·1 per cent. of the positive bilharziasis sera.

With carbolic saline extract, fixation occurred in 67·6 per cent.

Some of the negative cases gave also complement fixation with fluke extracts. This may be explained by the fact that these cases were not after all negative. Microscopical examination alone of the urine does not eliminate the possibility of bilharzia infection in a country like Egypt where the disease is widespread.

In addition, intestinal bilharziasis, which is also fairly common in Egypt, has not been excluded in the negative cases here cited.

Conclusion.

Alcoholic and watery extracts of *F. hepatica* possess antigenic properties against sera of bilharziasis cases, which can be demonstrated by the complement fixation test.

The diagnostic value of the test is limited, as practically 30 per cent. of the positive cases gave negative results.

F. hepatica extracts cannot be utilized for the diagnosis of *F. hepatica* infection in a man in countries where bilharzia is endemic.

VIII.—The Classification of the Family Ankylostominæ.

The classification of the Ankylostominæ has been the subject of discussion among helminthologists for a long time. Lane, in 1917, reviewed the subject and proposed to amend the definition of the subfamily Ankylostominæ, limiting it to the genus *Ankylostoma* only. This would appear to be justifiable, but he also proposed a new subfamily Necatorinæ synonymous with Bunostominæ, Looss, 1911, with certain amendations.

The reasons given by Lane for proposing a new subfamily were:

(1) The possibility that the genus *Bunostomum*, Rail., 1902, may be a synonym of *Monodontus*, Molin, 1681. Railliet and Henry had, however, disposed of this in 1910 in a paper entitled "Quelques helminthes nouveaux" in which they defined the genus *Bunostomum* and proposed the name *Eumonodontus* for *Monodontus* and defined it. The name *Eumonodontus* is now merely a synonym.

Colonial Medical Reports.—No. 179.—Cairo (*continued.*)

(2) Lane preferred to have the type of the family the genus *Necator*, which was more familiar than *Bunostomum*. This does not justify discarding a previously established family name.

Leiper, 1908, was the first to divide the bursate nematodes with a mouth capsule into: (*a*) those with a mouth guarded by a corona radiata—"Strongylinæ," and (*b*) those with dilated mouth capsule guarded by teeth or cutting plates and curved dorsally—Ankylostominæ. This is a classification based on very natural and outstanding characteristics.

Railliet and Henry, 1909, classified all bursate nematodes with a mouth capsule under the Ankylostominæ. Looss, 1911, raised the subfamily Ankylostominæ, Leiper, 1908, into a family rank Ankylostomidiæ. He restricted the subfamily Ankylostominæ to *Ankylostoma* and *Uncinaria*. The genus *Uncinaria* is certainly more allied to *Bunostomum* and *Necator* than to *Ankylostoma*. This is the view held by Lane, 1917, who restricted the subfamily to the genus *Ankylostoma* only.

The classification proposed by Hall, suppressing the family Ankylostomidæ, is a retrograde step on what had been advanced before.

The following scheme agrees in essential detail with Lane's classification with the single exception of re-establishing the subfamily Bunostominæ in an amended form.

FAMILY ANKYLOSTOMIDÆ, LOOSS, 1911.

Definition.—Bursate nematodese, with a horny mouth-capsule with its aperture pointing dorsally. No corona radiata. The family contains so far two subfamilies:

1.—Ankylostominæ, Leiper, 1908, amended Lane, 1917. Opening of mouth capsule is provided ventrally with paired chitinous teeth, vulva in the posterior part of the body. Type genus: *Ankylostoma*, Dubini, 1843. Type species: *A. duodenale*, Dubini, 1843. Other genera: *Galoncus*, Railliet and Henry, 1918. Type species: *G. perniciosus*, von Linstow, 1885.

KEY TO GENERA OF ANKYLOSTOMINÆ.

Mouth capsule greatly reduced in size and is provided with a dorsal cone and two dorsal lancets; inhabits cysts in the intestinal cell—*Galoncus*.

Mouth capsule was reduced in size; opening of dorsal œsophageal gland does not project freely into the mouth cavity, inhabits the lumen of the intestine—*Ankylostoma*.

2.—Bunostominæ, Looss, 1911, amended.

Opening of mouth capsule is provided with smooth chitinous plates, vulva about the middle of the body. Type genus: *Bunostomum*, Railliet, 1902. T. S. *Trigonocephalum* (Rud., 1908), Railliet, 1902.

Other genera: *Bustomum*, Lane, 1917. T. S.: *B. phlebotomum*, Raill., 1900. *Necator*, Stiles, 1903. T.S.: *N. americanus*, Stiles, 1902. *Brachyclonus*, Raill. and Henry, 1910. T.S.: *B. indicus*, R. and H., 1910. *Gaigeria*, R. and H., 1910. T.S.: *G. pachyscelis*, R. and H., 1910. *Bathmostomum*, R. and H., 1909. T.S.: *B. sangeri*, Cobbold, 1879. *Grammocephalus*, R. and H., 1910. T.S.: *G. clathratus*, Baird, 1868. *Monodontus*, Molin, 1861. T.S. *M. semicircularis*, Molin, 1861. *Uncinaria* (Froelich, 1789), Looss, 1905. T.S.: *U. criniformis* (Goeze, 1782), Raill., 1899.

KEY TO THE GENERA OF BUNOSTOMINÆ.

1.—Intestine with a diverticulum running towards head end. Teeth springing from floor of mouth with tips notched—*Grammocephalus*.

Intestine simple: 2.—Buccal capsule with shelf-like projections. Externo-dorsal ray arises from the corresponding branch of dorsal ray—*Bathmostomum*.

3.—Dorsal and externo-dorsal rays asymmetrical: Two ventral lancets in floor of mouth—*Bunostomum*. Two ventral and two dorsal lancets present—*Bustomum*.

4.—Bursa, pincer-like, dorsal lobe well developed; mouth with two ventral lancets only: Dorsal ray tridigitate; vulva in anterior half of body—*Gaigeria*. Dorsal ray bidigitate; vulva in posterior half of body—*Monodontus*.

5.—Buccal capsule with four lancets in relation to the dorsal cone: Externo-dorsal ray narrowed at its origin; spicules barbed at their tip—*Necator*. Externo-dorsal ray not narrowed at its origin; spicules not barbed—*Brachyclonus*. Buccal capsule with two ventral lancets only in relation to dorsal cone—*Uncinaria*.

Colonial Medical Reports.—No. 180.—Bihar and Orissa.

ANNUAL REPORT OF HOSPITALS AND DISPENSARIES IN BIHAR AND ORISSA FOR THE YEAR 1923.

By COLONEL H. AINSWORTH, M.B., F.R.C.S., I.M.S.

Inspector-General of Civil Hospitals, Bihar and Orissa.

THERE were 485 hospitals and dispensaries open on January 1 and 546 on December 31, 1923, an increase of 61.

The total number of patients treated at the State, public, local fund and private-aided dispensaries was 3,586,552.

DISEASES.

The year under review was a healthy one. The death-rate was 25·0 per mille compared with 24·1 in the preceding year. This slight increase was probably due to malaria and plague which were prevalent in certain districts.

The total number of deaths from cholera decreased from 26,805 to 8,198.

Plague was much more prevalent in 1923 than it was in the previous year; the death-rate per mille rose from 0·4 to 0·8. Certain districts of the Patna and Tirhut divisions were chiefly affected.

Small-pox was prevalent in certain districts during the year and the deaths increased from 2,560 in 1922 to 3,161.

Deaths from malarial fevers rose from 578,656 in 1922 to 599,840 in 1923. The total number of patients treated for malaria in hospitals and dispensaries was 932,508.

Quinine can be bought at offices of civil surgeons and sales are gradually increasing since the price of the drug fell.

26,439 patients were treated for influenza in hospitals and dispensaries in 1923. Vaccine was provided by Government to all civil surgeons and superintendents of jails, free of cost, and was available whenever required.

The total number of patients treated for the venereal diseases was 64,172. A special grant of Rs. 12,000 was made for the purchase of special drugs used in the treatment of syphilis. This grant was distributed to all Sadr and police hospitals and to many subdivisional dispensaries.

Rai Bahadur Dr. P. N. Das continued his investigation in connection with filariasis and read a paper at the Indian Science Congress on the results of his previous year's work. Ninety-two cases were treated by him in 1923, against 90 in 1922, with good results. A special hospital for the treatment of these cases has been built and equipped at Puri.

The number of cases treated for kala-azar increased from 17,212 in 1922, to 20,619. This increase is probably due to patients coming to hospitals more freely for treatment and not to an increase in the prevalence of the disease. The treatment by intravenous injection of various drugs appears to be increasing in popularity in many of the districts where the disease is prevalent.

The cases treated in hospitals and dispensaries for tubercle of the lung numbered 8,924 against 6,825 in 1922, and deaths among them were 131 and 116 respectively. There are no special hospitals for the treatment of these cases.

Ankylostomiasis is prevalent all over the province—the northern districts appear to be more heavily infected than others. During the year a special investigation was commenced by Dr. Korke in the Singhbhum district under the auspices of the Special Research.

In the ten leper asylums at work during the year there were altogether 2,082 resident lepers against 2,010 in 1922.

The buildings of the Ranchi Radium Institute have been completed and equipped. The successful treatment given in past years has drawn a large number of patients, and the rise in figures will show that the work of the institute is greatly appreciated. There were 189 new cases treated in the year under report against 86 in 1922.

Colonial Medical Reports.—No. 181.—Sudan.

ANNUAL REPORT OF THE SUDAN MEDICAL SERVICE ON CIVIL MEDICAL WORK IN THE SUDAN, FOR THE YEAR 1924.

General Considerations and Progress.

Considerable progress has been made along the lines laid down in last year's annual report, with a view to bringing medical help to the main mass of the population for the most part situated out of reach of the hospitals.

It is hoped thus not only to improve the general health and efficiency of the population and to prevent loss of life from endemic and epidemic diseases, but also in the less sophisticated areas by gaining the confidence of the people, to materially aid the administration and the development of the country.

Dispensaries and Assistant Medical Officers.

Seven assistant medical officers were passed out in the early part of this year and sent to dispensaries in various parts of the Sudan.

New dispensaries have been opened at Goz-Rageb in Kassala Province on the Atbara and at Karkoj in the Fung Province; the former to reach the large number of nomad Arabs who come down to the river from the Butana during the dry season, the latter to reach the people in a populous district which is becoming an important cotton growing area, and where kala-azar, malaria, bilharziasis and ankylostomiasis are endemic.

Two travelling dispensaries have been opened at Hillet Nuer and Abwong respectively, the assistant medical officers in question travelling round with the district commissioners and treating all sick who may collect. The sick treated on these tours are for the most part cases of syphilis and yaws, with a certain percentage of wounds, ulcers and eye diseases.

Dispensaries are also in course of construction at Talodi and Gebelein and will be opened at the beginning of next year.

Twenty small dispensaries are in course of construction or are already constructed in the irrigated area of the Gezira, one dispensary being placed in the centre of each 5,000 feddan block. Twenty sanitary hakims are in course of training for work in these dispensaries. Three of these dispensaries have already been opened and are doing very good work. The time of the sanitary hakims of these dispensaries will be divided between anti-mosquito work and the treatment of sick.

Anti-bilharzial Work.

Marked progress has been made with the anti-bilharzial campaign in Dongola Province, and there is every reason to hope that the disease will be stamped out in this Province in the course of the next two years. The great difficulty is the lack of adequate British supervision. It was only possible to spare a medical inspector for this work for two months during the year under report. It is hoped that a medical inspector will be able to be spared for four months during the ensuing year. The work is one of the utmost importance, as it is desired to prevent this disease spreading from this important reservoir of labour to the irrigated area of the Gezira. This would be a disaster.

Ankylostomiasis.

An ankylostomiasis survey has been commenced in Dongola Province, where this disease is known to be prevalent. It is hoped that it will be completed in the course of this winter and that a large number of the cases will by then have been cured.

Trachoma.

An especial effort has been made to deal with trachoma (Egyptian ophthalmia) in Dongola Province during the last year, but it is doubtful if any real progress can be made until a larger subordinate staff and increased British supervision can be provided.

Senna Dam Works.

Under this heading is considered the work at Makwar and the work on the main canal as far as Hag Abdulla. The results obtained during the past year have been extremely satisfactory. The malaria admission rate among the Egyptian labourers, who are the susceptible element, was further reduced to 1 per cent., and this in spite of the fact that the rainfall was an exceptionally heavy one, and that the first batch of labourers were brought up at the end of September instead of at the end of November, as in the previous year. The successful nature of these results is the more striking when it is remembered that Makwar used to be a malarial swamp of a very virulent type during the high Nile and the rainy season.

School of Medicine.

The opening of the School of Medicine took place last February. The ten students at present under training are reported to be making very good progress with their first-year subjects. It is hoped that it will be possible to admit a further class of students for training this January, when the present class has completed its first year's studies. The medical and surgical work at Khartoum and Omdurman Civil Hospitals has been reorganized with especial reference to the teaching work at the School of Medicine.

Syphilis.

Every hospital and dispensary carries out anti-syphilitic work. 22,260 injections of novarsenobenzol have been administered during the year. About half

of the work of the outlying dispensaries is anti-syphilitic work. There is reason to believe that the incidence of this disease has definitely diminished during the last eight years in the Northern and Central Sudan. In the areas in which anti-syphilitic work has been actively carried on during the last ten years, such as Omdurman and the Blue Nile Province, there appears to be no doubt that far fewer cases of primary and secondary syphilis are presenting themselves for treatment. It is not, however, possible to give definite figures to support this conviction.

Tuberculosis.

Two hundred and ninety cases were admitted to hospitals for tuberculous diseases during the past year The percentage rate is not increasing and this in spite of more accurate diagnosis.

It is believed that this disease is not on the increase, and that it will tend to decrease as the general standard of living improves and as malaria, worm infections and other debilitating factors are gradually got under control.

Dysentery.

There is a steady increase of the total number of cases, and in particular an increase of the number diagnosed as bacillary dysentery. The total increase is due to two factors: (i) The increased willingness to come to the hospitals for treatment; (ii) The increasing accuracy in diagnosis in out-stations. A great many cases which were formerly reported as diarrhœa are now reported as dysentery. This particularly applies to bacillary dysentery. The number of bacillary cases attending provincial hospitals is still very much understated.

The rise of the total cases from 531 in 1923 to 716 in 1924 is very marked. It will be necessary to watch the incidence of this disease very carefully, with a view to ascertaining if this increase is due to the reasons given above or if there is some other factor or factors involved.

Kala-azar.

This disease is endemic in the neighbourhood of the Blue Nile above Sennar, on the Dinder and the Rahad. The population in this region appears to be partially immune. The cases reported nearly always occur in people born and brought up in some other part of the Sudan, who spend a shorter or longer period in this endemic area. Thirty-two cases were seen in Singa district alone in the last nine months and there is reason to suppose that a far larger number of cases exists. An endeavour is being made to collect further evidence on this question.

Leprosy.

The information obtained is of necessity very incomplete, and especially so in the southern provinces where the tribes are not under close administrative control.

There appear to be many more cases in the Southern Sudan than in the Northern and Central Sudan. As regards the Southern Sudan, the disease appears to be widespread, but very little can be done until the confidence of the native has been more fully gained by the spread of general medical work. Later it may be possible to induce the natives to attend daily for out-patient treatment at hospitals in the few cases where they happen to be within reasonable reach of a hospital; or if too far away, to consent to be admitted to special leprosy wards or hospitals as in-patients. Every effort is being made, however, to treat patients with the resources at present at our disposal.

As regards the Northern and Central Sudan, the incidence of this disease appears to be much lower. The disease does not seem to be spreading and the position is not in any way very alarming.

At present, although the treatment of leprosy has made considerable strides, we are still not in possession of any specific cure. When a cure for leprosy has been discovered in any way comparable to its effect on this disease to that of novarsenobenzol on syphilis, then no stone will be left unturned to bring this cure within reach of every affected native, both in the North and in the South, but in particular in the South, where the disease is most dangerous.

Influenza.

This disease was widespread in the early months of the year, but the type was not severe and but few deaths occurred.

Malaria.

Owing to the more favourable spacing of the rains in the rainy season of 1923 the malaria incidence was not heavy. A severe local outbreak of malaria occurred at Nuri owing to extensive mosquito breeding taking place in the large number of pools left by the falling Nile and in wells. This in reality is attributable to lack of British supervision owing to shortness of staff.

Cerebro-spinal Meningitis.

Severe outbreaks of epidemic cerebro-spinal meningitis occurred in the Fung Province in March and September. 603 cases were reported with 138 deaths. The true totals were in all probability much higher.

Dengue Fever.

An outbreak of dengue fever occurred at Atbara in the early months of the year.

LEPER ASYLUM AT OMDURMAN.

This asylum is under the administration of the Sudan Medical Service, but the doctors of the Church Missionary Society hospital very kindly undertake the care and treatment of the patients.

Seventeen patients were admitted during the year, two were discharged as non-infectious and six died. There were twenty-eight patients in the asylum at the end of the year, fifteen of whom were men and thirteen women.

Fifteen of these have been found to be non-infectious and will be discharged as soon as arrangements can be made for their maintenance after discharge.

Colonial Medical Reports.—No. 181.—Sudan (*continued.*)

Two hundred and fifty-six intramuscular injections of moogrol were administered. The doctor in charge notes considerable improvement in the general condition of the patients. He attributes this largely to the more liberal diet given in the leper asylum; patients before admission are often very undernourished—but he thinks that the moogrol injections have also contributed to this improvement. He is not, however, enthusiastic as to the results obtained by the use of this drug.

EPIDEMIC JAUNDICE.

An outbreak of epidemic jaundice occurred in an isolated working party at Railhead during the months of February and March, 1924. Ten cases, including one British inspector, attended for treatment. Six of the cases were mild and were treated at Railhead; the remainder were evacuated at Atbara and Port Sudan. The following short summary of the symptoms, &c., by the Medical Inspector in charge at Railhead, is of interest:—

Symptoms.—Attacks were preceded by either diarrhœa or constipation.

The illness generally started with a rise of temperature, headache, lassitude, loss of appetite, and nausea.

Vomiting.—Occurred in half the cases.

Pain.—Four of the patients had considerable pain and tenderness in the epigastrium and right hypochondrium.

Liver.—Was definitely enlarged in three cases.

Fever.—Temperature rose abruptly to 100°-101° F. at onset and remainder between 99°-100° F. for about seven to eight days.

Stools.—Pale in colour—in three cases definitely clay-coloured.

Urine.—Highly coloured—bile salts present—no albuminuria.

Jaundice—Present in all cases at some stage.

Usually became obvious on third or fourth day of illness and continued for nine to ten days.

Complications.—One case treated at Port Sudan Hospital relapsed on return to Railhead.

He had all the above signs and symptoms, but his liver was not enlarged. He developed acute ascites and died from heart failure.

The remaining cases made an uninterrupted recovery.

Causation—No definite cause for the outbreak could be traced.

The epidemic was confined to this party of fifty men.

Their food and water supply was from the same source as for the main camp.

Flies were very prevalent in this area, but not more than elsewhere.

Colonial Medical Reports.—No. 182.—Bengal.

ANNUAL REPORT ON THE WORKING OF HOSPITALS AND DISPENSARIES UNDER THE GOVERNMENT OF BENGAL, FOR THE YEAR 1923.

By R. HEARD.

Surgeon-General with the Government of Bengal.

CALCUTTA HOSPITALS AND DISPENSARIES.

Number.

Twenty-four hospitals and dispensaries were working in Calcutta at the beginning of the year under report. During the year two new institutions were opened, viz., the Entally and the Taltola Municipal Dispensaries which treat out-patients only, thus raising the total number of institutions to 26 in the latter part of the year. Seventeen of these institutions have indoor accommodation while the remaining nine treat out-patients only.

Beds.

The total number of beds provided in the 17 indoor hospitals was 2,903 as against 2,857 in the previous year. The Sree Vishudhananda Saraswati Marwari Hospital, a private non-aided institution, showed an increase in its beds from 35 to 83, and the Medical College Hospitals provided 8 more beds. On the other hand, in the Campbell Hospital there was a decrease of 10 beds owing to the conversion of one of the annexes into a theatre for septic operations. Thus there has been a net increase of 46 beds.

Patients Treated.

The total number of patients treated during the year was 416,019 (40,755 in-patients and 375,264 out-patients) as against 438,899 (39,867 in-patients and 399,032 out-patients) in the previous year, or a decrease of 22,880 patients during the year. There was an increase of 888 in-patients, but a decrease of 23,768 out-patients. The introduction of the system of charging small fees in the Medical College, Campbell, Sambhu Nath Pandit and Presidency General Hospitals, together with the comparative absence of epidemics, accounts for this falling off in the attendance of patients during the year. There was a noticeable increase of attendance in the out-door departments in the Carmichael Hospital for Tropical

Diseases, the Kidderpore Municipal Dispensary, the Chitpur Dispensary, the Carmichael Medical College Hospitals, Belgachia, and the Sree Vishudhananda Marwari Hospital, where the system of charging fees was not in force. There was no marked increase or decrease of in-patients in the other hospitals.

The death-rate among in-patients remained practically at the same level as in the previous year, viz., 11·26 per cent.

Diseases.

Cholera.—The outbreak of cholera in 1922 was of a mild character as compared with the epidemic of 1921. In 1923, the total number of in-patients treated was 1,302 with 274 deaths as against 1,527 with 311 deaths in the previous year. The number of out-patients treated in 1923 was 161 as against 226 in 1922.

Kala-azar.—The prevalence of this disease is becoming more and more revealed, and 5,599 patients were treated as against 2,940 in 1922. The results of treatment with antimony are reported to be very good, and the popularity of this treatment accounts for the increase in admissions to these hospitals.

Malaria.—With the exception of diseases of the eye, malaria was responsible for the largest attendance, although the total number of cases treated during the year under review fell from 42,342 in 1922 to 33,980 in 1923. The total number of in-patients treated in all the hospitals was 2,226 and the death-rate was 4·58 per cent.

Small-pox.—The incidence of small-pox was low; only 108 cases were recorded in the Calcutta hospitals as against 356 in 1922. The number of in-patients treated was 76 with 21 deaths as against 283 with 96 deaths in 1922.

Influenza.—This disease was present in sporadic form throughout the year. The incidence of the disease has been gradually decreasing since the epidemic in 1918, the number of patients having fallen from 16,784 in that year to 6,447 in 1923. The mortality from this disease was 15·74 per cent.

Plague.—The number of plague patients treated in the Calcutta hospitals was 29 as against 71 in 1922. The mortality was high, the average death-rate being 92·30 per cent.

Tubercle of the Lung.—The attendance of patients suffering from this disease was greater than that in the previous year, viz., 3,251 as against 2,595. The number of in-patients treated was 790, and the average death-rate 51·52 per cent.

Venereal Diseases.—The total number of patients treated for venereal diseases was 19,782. Of the former number, 5,436 males and 2,100 females suffered from gonococcal infection and 6,232 males and 2,301 females from syphilis, while 2,749 males and 964 females suffered from other forms of venereal diseases. The total number of in-patients treated during the year was 1,699.

Diphtheria.—One hundred and thirty patients were treated in the Diphtheria Ward of the Medical College Hospitals, with a mortality of 23·07 per cent. Tracheotomy was performed in 50 cases, of which 28 ended fatally.

DISTRICT HOSPITALS AND DISPENSARIES.

The number of dispensaries in 1922 was 859. During the year under review 60 new dispensaries were opened and 5 were closed, a net increase of 55 dispensaries as compared with 32 in the preceding year, and the number of dispensaries at the end of the year was 914.

The system of subsidizing private medical practitioners was also adopted in the districts of 24-Parganas, Faridpur, Dinajpur and Khulna, and 9,212 patients were treated under this arrangement, the number of private practitioners subsidized being five.

The number of homœopathic dispensaries in existence during the year was 27, 13 Ayurvedic dispensaries and only 2 Unani dispensaries, in which 64,860 patients received treatment.

Patients Treated.

The number of patients treated in mufassal areas in allopathic institutions was 7,082,603, and includes 182,248 patients treated at dispensaries opened during the year under report.

As usual, the largest number of patients treated suffered from malaria, viz., 2,101,954. Next come in order of frequency diseases of the respiratory system other than pneumonia, tubercle of the lungs, diseases of the eye and ear, and of the stomach and intestines. The total number of patients who sought medical relief in the indoor wards of all classes of hospitals (allopathic) was 61,975, with a mortality of 6·38 per cent.

Diseases.

Malaria.—Slightly over one-third of the total number of patients treated in the district hospitals and dispensaries suffered from malaria. Altogether 2,101,954 patients were treated as against 1,988,577 in 1922. The largest number of malaria cases occurred in the districts of Burdwan, Rangpur, and 24-Parganas. Treatment by injections of quinine bihydrochloride was largely resorted to, and satisfactory results are reported. During the year 1,736 lb. of quinine-sulphate (value Rs. 46,937) were sold by the Juvenile Jail to charitable hospitals and dispensaries under Government supervision. The Director of Public Health, Bengal, also distributed to these dispensaries free supplies of quinine and cinchona febrifuge.

Influenza.—Altogether 51,769 patients were treated as against 62,152 in 1922. The greatest number of cases occurred in the districts of 24-Parganas (6,955), Mymensingh (6,342), Murshidabad (4,466), and Hooghly (4,399).

Cholera.—There were only 8,389 cases of cholera as against 9,475 in 1922. Altogether 241 deaths were recorded as compared with 332 in 1922. The disease was most prevalent in Dacca district.

Small-pox.—From the statistics received it appears that the epidemic of this disease, which broke out in 1919 and persisted in 1920, has been steadily decreasing. The number of cases has fallen from 1,848 in 1920 to 282 in 1923. The total number of deaths recorded was only 10 as against 15 in 1922.

Venereal Diseases.—The total number of patients

treated for venereal diseases was 82,575 as against 78,957 in 1922. Treatment with arsenobenzol preparations has proved satisfactory.

Tubercle of the Lung.—The number of patients treated for this disease rose from 6,262 in 1922 to 6,827 in 1923. In the two previous years, viz., 1920 and 1921, the numbers were 5,824 and 5,805 respectively.

Kala-azar.—Cases of kala-azar are being diagnosed in increasing numbers. The number of patients treated in 1923 was 34,264 as against 15,566 in 1922. The disease is generally diagnosed by the aldehyde test, and the usual treatment is with injections of antimony preparations. Injection of a two per cent. solution of potassium-antimony tartrate or sodium-antimony tartrate is commonly employed, but the former is regarded as more satisfactory. In many districts training centres have been opened to impart instruction in the diagnosis and treatment of this disease. The greatest number of kala-azar cases was found in the Mymensingh district. It is reported that a few years back the disease was unknown in Mymensingh, but now it is found to be present everywhere in the district. The disease is prevalent in the districts of 24-Parganas, Noakhali, Dacca, Tippera, Hooghly, and Nadia.

Leprosy.—Altogether 4,144 patients were treated for leprosy, viz., 713 in the special Leper Asylums at Gobra, Raniganj, and Bankura, and 3,431 in general hospitals and dispensaries. The corresponding figures for the previous year were 804 and 1,385 respectively.

GENERAL.

The year under review has been marked by a rapid increase in the number of dispensaries, the District and the Union Boards playing a conspicuous part. The general health of Bengal was better than in the two previous years. The financial condition of many mufassal institutions, has, however, been unsatisfactory. In some places civil assistant surgeons have been replaced by sub-assistant surgeons, and in others, sub-assistant surgeons have been replaced by private practitioners. Subscriptions in many cases have remained in arrears. The introduction of the system of charging small fees has not been popular; in some districts it has led to an increase of income, but in others it has seriously interfered with the collection of subscriptions.

Colonial Medical Reports.—No. 183.—British Guiana.

ANNUAL MEDICAL REPORT FOR BRITISH GUIANA FOR THE YEAR 1923.

By P. JAMES KELLY,

Surgeon-General.

PUBLIC HEALTH (GENERAL.)

THE population of the Colony on December 31, 1923, was estimated at 299,199. There were 9,109 births and 8,468 deaths.

GENERAL DISEASES.

(*a*) *Tuberculosis.*—The number of deaths registered as due to tuberculosis was 394.

The Society for the Prevention and Treatment of Tuberculosis established in 1907, has, as usual, rendered good and efficient service.

There are Tuberculosis Dispensaries in Georgetown and New Amsterdam, and Tuberculosis Clinics are regularly conducted in rural Medical Districts at Schoon Ord, West Bank, Demerara, and Buxton, East Coast, Demerara.

The Tuberculosis Hospital at Best (near Georgetown) designed for the treatment of early cases of tuberculosis, has had under treatment during the year 28 males and 11 females. There were 7 deaths—4 males and 3 females.

(*b*) *Enteric fever.*—There were 476 cases of enteric fever notified in the whole Colony and 117 deaths.

During the year 4,026 doses of typhoid-para-typhoid vaccine were supplied by the Bacteriological Department.

(*c*) *Diphtheria.*—Thirty cases were notified during the year with 6 deaths. Ten of these cases and 3 deaths occurred in Georgetown.

(*d*) *Chicken-pox.*—The number of cases notified was 29, of which 8 were in Georgetown.

(*e*) *Pneumonia.*—The mortality from pneumonia was 772.

As in the previous year a large proportion of these cases was of influenzal origin.

(*f*) *Bright's disease.*—The number of deaths from Bright's disease and acute nephritis was 780 and 61 respectively.

LOCAL TROPICAL DISEASES.

(*a*) *Malaria.*—The deaths registered as due to malaria numbered 1,080.

The number of deaths from malaria in Estates Hospitals was 120.

The Mazaruni and Potaro River areas, where the diamond and gold fields exist, are unfortunately highly malarious and a large percentage of miners contract the disease while engaged in these industries. With the further development of these mining areas and an

increased mining population it is anticipated that the Colony's malarial statistics will be materially influenced for the worse. The type of malaria contracted in these regions is usually of the subtertian variety with severe gastric and intestinal (malarial dysenteric) symptoms.

(*b*) *Ankylostomiasis.*—With the introduction of carbon tetrachloride the disease is being kept under better control, especially on sugar estates where routine examination of estate labourers is made by the medical officers. The number of cases treated in Government and Estates Hospitals during the year is 651.

(*c*) *Dysentery.*—This disease is most prevalent in the rainy season from November to February.

The number of cases treated during the year was 936. This disease is mostly of the bacillary type. Some cases of amœbic dysentery occur and some that conform to neither species.

Onderneeming Industrial School for Boys.

The daily average number of boys was 159·6 and of this daily average the percentage sick amounted to 2·98. The chief diseases were malaria, fever and ulcers. There were 37 cases of malaria. There were 5 cases of blackwater fever. Ankylostome infection has been controlled by routine inspection and treatment. In December, 1923, the percentage infected was 7·8. The number of cases transferred to the Public Hospital, Suddie, for treatment was 36.

Urban Districts.

In the City of Georgetown there were 1,883 births. There were 1,583 deaths. The infant mortality was 184 per 1,000 registered births. There were 168 notifications of enteric fever and the number of deaths was 40. Malarial fever was the cause of 63 deaths in the city.

Filaria.—The number of cases with deaths due to filariasis during the year was 298 and 11 respectively.

The total number of deaths registered in the Colony was 55.

In this connection a special report has been published by the London School of Tropical Medicine —"Research Memoir Series—Volume V, Memoir 7, 1924. Filariasis in British Guiana. (A Report of the Filariasis Commission, 1921)."

Rural and Village Areas.

Sanitation, as in the previous year, is much handicapped owing to physical and meteorological conditions. The lack of proper drainage in the inhabited areas of the low-lying coastal belt and the consequent accumulation of stagnant water, furnishing mosquito-breeding areas, are the main problems to be contended with.

Malaria is the most prevalent disease and is particularly fatal in the case of infants, due to its assuming the cerebral type.

The drinking-water supplies, except where artesian wells exist, are not satisfactory, especially in periods of drought. The best solution of this problem is dependent on the extension of artesian well-water supplies.

The latrine systems and disposal of sewage in rural areas are also defective and the situation is complicated through periodical floodings and lack of proper drainage.

Annual Report of the Government Medical Officer of Health for the Year 1923.

Introductory.

Preliminary remarks as to the Colony's position and the physical features of the inhabitated portion were introduced into the report for the first time in 1922. That information has this year been summarized.

The year 1922 was remarkable for its very moderate rainfall throughout the middle portion of the year. The "long wet season" of May, June and July was represented by moderate rain at intervals and none of the usual flooding occurred. The later rains were delayed and before their arrival in December the shortage of water had begun to be felt in several districts.

The very heavy rain of December once more emphasized the urgent need of drainage of the coastlands. Deep inundation of many villages occurred.

The past year will always be historic in the health matters of British Guiana. In 1923 the prolonged negotiations for the sewering of the capital were completed and the contract for the work was signed. In that year also were initiated definite schemes for the drainage, irrigation and water supply of the coastlands.

Of the total deaths in 1923 (whole Colony) 1,080 were due to malaria, 117 to enteric fever, 1,165 to bowel complaints other than enteric fever, 710 to diseases of early infancy, 842 to kidney diseases, 394 to tuberculosis, and 55 to filaria.

Notes on Principal Diseases.

Malaria.—The deaths registered as directly due to malaria numbered 1,080.

This heavy mortality and the vast, though unrecorded, loss of working efficiency and of working time which malaria causes year by year are features of the Colony's life whose importance has long been urged by members of the medical service but which hitherto has not been grasped by the public.

Recent speeches by public men show that the idea still prevails that malaria prevention is an affair for the doctors. It cannot be too emphatical'y stated that it is no longer so. The way has been pointed out, the methods have been elaborated and the results of inaction have been proclaimed in and out of season. There is one essential, without which anti-malarial work in this Colony is like ploughing the ocean, namely, good main drainage. This is, perhaps, at last in sight, but when that is accomplished there will still be required a vigorous public opinion to strengthen the hands of those who must see to the carrying out of what Dr. Wise in 1919 called the "small, petty, irritating details, ... small in themselves but of vital importance in the war with malaria."

Colonial Medical Reports.—No. 183.—British Guiana *(contd.)*.

The conscientious carrying out of such duties is still resented by many of the people and by some of their representatives as unwarrantable interference with personal liberty.

Enteric fever (including paratyphoid).—This disease did not assume epidemic character during 1923.

Sex incidence of enteric fever was in the proportion of 100 males to 69 females, the respective numbers notified being 175 males and 121 females.

The age incidence showed the usual preponderance of cases during the years of childhood, adolescence and early adult life. 71 per cent. of all cases were between the ages of 6 and 30 years. The usual disinfection of premises and chlorination of water vats after the occurrence of cases of enteric were carried out.

Tuberculosis.—459 cases were notified, with a death rate of 1·3 per 1,000 persons living (whole Colony).

The Society for Prevention and Treatment of Tuberculosis has carried on its usual work of combating this disease. Throughout the year the Government Medical Officer of Health has been the Honorary Secretary and a visiting Physician of the Society. The Annual Report of the Society contains a full account of the work in connection with this disease.

Other infectious diseases were notified as follows, diphtheria 30; chicken-pox 29; cerebro-spinal meningitis 1; and alastrim 1.

Leprosy.—Throughout the year the Medical Officer of Health has visited discharged lepers from time to time. The conditions under which the rural population of British Guiana lives are seldom if ever such that satisfactory home isolation can be carried out. It would be better to discharge from the asylum only those cases in which the disease has been definitely arrested.

Ankylostomiasis.—Colonial statistics are not available, but the frequency of infection admits of no doubt. Little diminution is to be looked for until satisfactory conservancy is the rule instead of the exception; and fair conservancy for country districts will for the first time become a practicable proposition when the drainage works now foreshadowed are an accomplished fact. Where it is possible to combine therapeutic and preventive measures this disease has in this Colony as elsewhere been kept down to a minimum.

Notes on Leprosy and its Treatment, from Observations made in the Leper Asylum, Mahaica, during the Year 1923.

Plea for an Anti-leprosy Campaign.

The vast majority of cases of leprosy admitted in this asylum are in an advanced stage of the disease. This is very regrettable, as in this way any specific treatment that may from time to time be advocated elsewhere is given here but a poor chance. Further, no effective control of the disease can be hoped for if lepers are left at large for such a long time before they are isolated in the asylum or elsewhere, and properly treated.

A local anti-leprosy campaign was suggested to the Government. This should start with a systematic search for lepers at large, throughout the Colony; this search should be missionary in character, and not such as to suggest in any way a police hunt; its object, fully explained beforehand to the public, should be chiefly to bring within the reach of every leper in the Colony the most successful treatment of the disease. In suitable cases opportunity could be given to patients to be treated in their village, under conditions of proper isolation. In other cases patient explanation and gentle persuasion very often will succeed to make the patient decide to seek admission in the asylum, even before the machinery of the law is put into action to compel him to do so.

It might be pointed out here that a few lepers have voluntarily walked into the asylum, and come to me for treatment. One of them stated that, apart from any hope of improving under the treatment, he thought the asylum was the best place for him, as he was afraid of passing on the disease to his family if he remained at home.

Education of the people, hence, may be a valuable help towards stamping out the disease from the country; it may bring more patients to the asylum, and, above all, it will make them come earlier.

It was also suggested putting into effect one of the recommendations made (indirectly) by the Leprosy Relief Association; the periodical examination of the members of the family of every leper—with this modification, that instead of limiting this examination to "members of the family" it be extended to all the "contacts," that is to every person who has been in close association with the leper.

Early Diagnosis.

This is of course of prime importance, from the point of view of treatment; the opinion of recent observers is that leprosy is non-infective in the early stages, so that isolation does not seem to be imperative then.

Prodromata has been described. In the case of nodular leprosy: pyrexia, dyspeptic troubles, drowsiness, epistaxis, profuse sweating. I have been able to trace one or more of these symptoms, from the history as told by the patient, but they do not occur with regularity or constancy; also, they are common to so many other conditions. In the case of maculo-anæsthetic leprosy, shooting pains (or "lancinating") may occur very early, and are often described by lepers as rheumatism.[1]

These prodromata, apparently of little use, considered by themselves, to the clinician may assume some diagnostic importance if associated with a family history of leprosy in particular cases.

A few inmates declare that they suffered from a persistent cold in the head for some time before any definite signs of leprosy made their appearance. In view of the possibility of the transmission of the disease (or, at least, one of the modes of transmission)

[1] Other early signs: (1) Bullæ on the extremities, resulting in sores; (2) Starting contracture of fingers, with bending of little finger.

occurring through the naso-pharyngeal mucosa, this information gathered from inmates is worth while recording.

Differential Diagnosis from Syphilis.

The initial manifestations of maculo-anæsthetic leprosy—the leper spot, or spots, associated, perhaps, with lancinating pains—may give rise to a mistaken diagnosis. This has positively happened, and it may not be without prejudice to the patient. Once syphilis is suspected, the blood is tested, and if a positive Wassermann is obtained the diagnosis is considered as confirmed, and novarsenobillon is injected.

Now a positive Wassermann test is often obtained in leprosy. Further, novarsenobillon, or arsenic in other form seems to be harmful to maculo-anæsthetic lepers.

Novarsenobillon has been tried in a few cases; in the maculo-anæsthetic cases it aggravates both the anæsthesia and the ulcerations, or the maculæ (these extend). In one case, liq. Fowleri has the same effect. As these observations have been made only on a small series of cases they may not seem very conclusive. However, it must be remembered that both arsenic and the *Bacillus lepræ* cause peripheral polyneuritis, hence it is not surprising that the former tends to aggravate a condition caused by the latter.

Hence the differential diagnosis between leprosy and syphilis is not without importance. As this is one of very few exceptions to the specific value of the Wassermann test, if borne in mind, it may not often be the cause of a mistaken diagnosis. A nasal smear will clear up the doubt. Also leprous sera react with tuberculin, whereas syphilitic sera do not —according to some observers.

The Initial Eruptions of Leprosy (and their Relation to other Symptoms).

It seems that when the leper spot comes out, diagnosis is relatively easy.

In nodular cases this initial eruption is an erythematous patch, red or reddish-brown in negroes, purplish in fair persons; it is generally roundish, varying in size, but often about an inch in diameter; it is raised above the surface, and the edges are sharply marked; it is often tender, or "burning."

This "leper spot" appears most often on the face, cheek or forehead; on the outside of the thighs and on the hips; sometimes on the anterior aspect of the forearms. After a variable interval the spot (or spots, as more may follow the first one) may disappear, or almost disappear, to be followed by the appearance of nodules, on the same spot or elsewhere.

In the maculo-anæsthetic cases, the initial eruption is a yellow roundish spot, well defined, but not raised above the surface; it becomes numb later on. The site of the eruption seems to be more variable than that of the eruption of nodular leprosy; it is often on the hip or on the face, but also on the chest, back, hands and knees.

In some cases the spots are anæsthetic from the first, but often they do not become so until some time afterwards—may be several months after their appearance. However, anæsthesia in the extremities (as distinct from that in the patch itself) is usually an early sign; this loss of feeling in the fingers, generally those innervated by the ulnar nerve, is detected early by the patient.

Loss of muscular power appears later on. Atrophy of the interossei muscles of the hand, resulting in the "main en griffe" is one of the most common results.

After a variable time (from the appearance of the "spots,)" often a couple of years, the spots enlarge peripherially, their edges become raised and often studded with very small vesicles. These enlarged patches are pale-whitish in colour, dry and numb. This is soon followed by deformity, mutilation, and the formation of trophic ulcers.

Mixed leprosy generally begins as one of the forms described above, and after some time, often several years, signs and symptoms belonging to the other form are superadded. Thus it may commence as a maculo-anæsthetic case, nodular infiltration following the nervous manifestations, or vice versa. Sometimes symptoms and signs of one form may appear simultaneously with those of the other form. Thus a nodular leper spot may appear on the face, and anæsthesia in the fingers.

Transmission of the Disease.

The theory of heredity, in a scientific sense, is not supported by facts as far as can be gathered from past and recent literature—unless it is changed into "hereditary predisposition," when the position will become similar to that of tuberculosis. No doubt leprosy runs in families, as shown by many cases in this asylum; this may only mean that members of the same family are in a favourable condition for the transmission of the infection from one to the other.

It seems that in one or two cases, children born in this asylum, and removed from the mother immediately after birth, have contracted the disease afterwards. No exact data are available, and of course there is nothing to prove that these children did not contract the disease outside the institution, through prolonged contact with a leper.

Whatever the usual mode of transmission may be, it seems very probable that in some cases the disease has been contracted through sexual intercourse; the history of these cases point very clearly to this. If this danger were known to the public, it would exert some restraint on the spreading of venereal disease, besides possibly helping to control the spread of leprosy itself.

Aboriginal Indians free from Leprosy.

No case seems to have ever occurred of an aboriginal Indian contracting leprosy. Among other persons, missionaries have passed several years among these Indians, but they never saw any of them afflicted with anything like leprosy.

It may be mentioned here that the worst case in this asylum is that of a young Boviander girl; she is covered with ulcers, and no treatment, however persistent, has been of any use.

It is possible that some racial immunity, however

feeble, present in afflicted races, but not in the Buck Indians, may account for the severity of this case.

Treatment—Ol. Chaulmoogræ and Moogrol.

In 1922, moogrol was used exclusively, and it was given intramuscularly, as recommended by the makers, in doses of 1 c.c. to 6 c.c. at first; later in the year the dose was boldly increased up to 10 c.c. (5 c.c. or 6 c.c. is the recommended maximum) without any ill effects.

In 1923 the intravenous method has been tried, and compared with intravenous ol. chaulmoogræ.

The intravenous method of injection is superior to the intramuscular one in some respects, it does not cause pain, indurations, or abscesses.

Ol. chaulmoogræ is not convenient for injections. It is very dense, and a large-bore needle is therefore required; and only a very good syringe can draw it up in a short time. Also when injected intravenously it causes, in almost every case, a violent fit of coughing, due, it appears, to the formation of fat emboli in the pulmonary capillaries; this may not be without dangers, considering that a good number of lepers are also consumptives.

Moogrol on the other hand is a light, mobile liquid, very easily injected through fine needles. It does not cause the violent fits of coughing mentioned above.

The effects of the two preparations are the same. In several cases, however, the action of moogrol is more decided and more rapid.

These effects confirm the conclusions drawn from the series of cases treated in 1922. Moogrol (and also ol. chaulmoogræ) is capable of improving the condition of the lepers, and its action seems to be specific. The best results are obtained in early cases.

The treatment must be persistent. In many cases, the effect of repeated courses of treatment is cumulative; patients who had improved in 1922 up to a certain stage and then become stationary for a time, showed further improvement in 1923, after another series of injections.

By course of treatment is meant a series of six injections, weekly, starting from 1 c.c., and increasing the dose by 1 c.c. every week; this is the method I adopted after some trials. Often the last dose is repeated, 6 c.c. once or twice, in cases showing a very active stage of the infection, but otherwise relatively healthy. After an interval of six weeks—during which another series of cases are being injected—cases from the first series are given a second course, and so on, modifying the method to suit the gravity of the cases and the number of patients willing to be treated.

Record syringes are exclusively used for these injections as the most suitable for aspirating oily fluids and these are accurately graduated in cubic centimetres. A few needles are kept in continuously boiling water, and used in rotation, so that a perfectly sterile needle is used for each patient.

The syringe itself is sterilized in the same way, in the first instance, and disinfected after every injection in Ac-Carbol 1 in 20

The effects observed in 1922 have been obtained again in 1923; nodules tend to soften and become absorbed, or break down and heal within a short period. Nodules that were ulcerated for some time heal up. Anæsthesia is partially relieved — the "tingling" sensation completely relieved in some cases.

The effects in early maculo-anæsthesia cases are pretty constant, and hence a probable prognosis can be attempted; the discoloured patches assume the colour of the surrounding skin, completely (or almost) disappearing; and the anæsthetic area contracts considerably, but very often a small anæsthetic or hypoæsthetic area persists. Also, the weakened hand-grip due to muscular paresis is strengthened. It is unfortunate that these early cases that come under observation in this asylum are so few.

Laboratory findings.—Very often, especially in bad nodular cases, a positive finding becomes negative after some methods of treatment, but not always so; so this may be accidental. Fragmentation of bacilli and loss of their staining properties (acid fast) have been noticed. This, however, has been known to take place in untreated lepers, and may be the result of a natural defensive process.

Conditional Discharges.

Many cases, among the maculo-anæsthetic ones, can be discharged with relative safety, but it is always desirable, and instructive, to follow up these cases for a time—hence the usefulness of conditional discharges.

At present the conditions under which district Government medical officers are willing to tolerate the return of a discharged inmate to his district are not very clearly definite, sometimes too vague, or tending to be chaotic. Perhaps something could be done to make the position clearer, so as to have some guidance in recommending discharges.

Re-admission and Relapses.

It is well to point out that a re-admission need not mean a relapse—often it does not. A case frequently met with is that of a maculo-anæsthetic inmate, free from all signs of active leprosy for a long time, but, of course, deformed and mutilated as the result of the disease, with nerves partially destroyed, atrophic patches of skin and anæsthetic areas—in other words, in a state of very poor and unstable trophism. A small trauma in such a person (a scald for example) will easily cause a purely trophic, non-specific ulcer; this superficial ulcer, plus the old anatomical changes, which nothing short of a miracle can ever cure, set in motion the machinery of the law—result, a re-admission.

A provision could be included in the asylum rules, whereby in such cases, if the medical superintendent is satisfied that the re-admitted patient is as fit to be discharged as he was before, he could be discharged in a more expeditious way than usual.

An Improved System of Recording Cases.

The adoption of the "Index Card System" of making notes on cases is suggested. It is superior to any book system, being more elastic, and affording a quick and easy means of reference for taking statistics, etc., in fact for the study of leprosy in general.

The cards will be indexed alphabetically, different colours showing the various forms of leprosy (i.e., white for nodular, blue for maculo-anæsthetic, pink for mixed).

This system will ensure uniformity in the keeping of records by the successive medical superintendents. Also it will provide a quick but accurate method of recording cases. This is very desirable as the duties of the medical superintendent are multifarious, and on some days anything, from a fight between inmates to an unreliable contractor, may distract him for a considerable time from scientific work.

Colonial Medical Reports.—No. 184.—Calcutta.

REPORT OF THE HEALTH OFFICER OF CALCUTTA FOR THE YEAR 1923.

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HEALTH DEPARTMENT.

Vital Statistics.

The death-rate.

The number of deaths registered during the year was 25,824, equivalent to a death-rate of 28·5 per thousand calculated on the census population for 1921. This is a slight improvement on the returns for 1922. Though slight, it is very satisfactory to be able to point to a steady and uninterrupted fall in the general death-rate of the city for four years in succession, viz., from 42·2 per thousand in 1919 to 28·5 per thousand in 1923. Though still much higher than in 1916-17, *i.e.*, the years preceding the terrible series of epidemics of influenza, the death-rate now corresponds very closely to the average rate recorded from 1910-1915. The total general mortality figure of 25,834 includes 1,745 imported deaths. Excluding these, the death-rate for 1923 becomes 26·5 per thousand. Unfortunately, as no correction for residents of Calcutta dying outside the city is possible, this cannot be accepted as a corrected death-rate. As pointed out last year, if nearly 2,000 persons already suffering from various diseases, frequently infectious in character, enter the city and die, there are probably many more immigrants also infected who recover, not to mention contacts, "carriers," &c.

These figures give some idea of the constant stream of infection which is pouring into the city by rail, by river, and by road. Obviously the prevention of epidemics in a large Oriental city under these circumstances is an extremely difficult task.

Variations in the mortality from different causes.

Plague.—A mild recrudescence of plague, which hardly merits the term epidemic, occurred and caused 77 deaths, *i.e.*, almost half the number recorded in 1922.

Cholera.—The epidemic of cholera was one of the mildest ever recorded in Calcutta. The number of deaths was only 914 as compared with 1,269 in 1922 and 1,997 in 1921. In fact it only caused 48 more deaths than the remarkably mild epidemic of 1917, which is the record for Calcutta.

Small-pox.—Another comparatively localized outbreak occurred this year also, but it was of a much milder character, the number of deaths being only 157 as compared with 450 deaths in 1922.

Influenza.—The number of deaths recorded as due to influenza was 371, little more than half the number registered in 1922. There has been a steady fall in the number of deaths from influenza for the last five years.

The mortality from other principal diseases included malaria, enteric, other fevers, dysentery, &c., tuberculosis, and measles.

The most satisfactory feature is the fall in the mortality from tuberculosis, as until this year the death-rate had been steadily rising ever since 1917.

The rise in the mortality from other fevers is probably due, in part at any rate, to the debilitating effect of the severe and widespread epidemic of dengue. As to the rise in the mortality from enteric, it is difficult to say how far this is real and how far apparent in view of the wider application of the Widal-Grunbaum reaction nowadays.

Mortality Rates and Principal Causes of Deaths Amongst Infants.

The infantile mortality rate calculated on the number of births registered was 294 per thousand, slightly higher than in 1922, when it was 287 per thousand. The correctness of this death-rate depends not merely on the accurate registration of deaths, but also on the accurate registration of births, a much more difficult task.

The total number of deaths amongst infants was 5,366, a slightly higher figure than in 1922, when 4,980 deaths were registered. As already noted, the infantile mortality for the two years is practically the same owing to an improvement in birth registration this year.

The principal causes of infantile mortality are: bronchitis, congenital debility, tetanus neonatorum, premature birth, diarrhœa and enteritis, infantile liver and other causes.

Colonial Medical Reports.—No. 184.—Calcutta (*contd.*).

One of the most striking features is the very large proportion of infants that die during the first week of life. No fewer than 1,831 or more than a third of the babies born in Calcutta die within a few hours or a few days of birth.

The birth of so many weakly babies doomed to die in such a short time is a serious problem. It is, of course, mainly due to antenatal conditions and cannot be remedied by baby clinics, milk depots, &c. With so many sickly, poorly-nourished mothers living under insanitary conditions, puny, weakly babies are inevitable. Whilst poverty is the direct cause of so many expectant women being ill-fed and badly housed, ignorance, child marriage, the purdah system and disease all combine to undermine their health. Although many premature births result from the conditions briefly noted above, there is no doubt that a large proportion are due to syphilis. Making every allowance for the well-known effect of chronic malaria in causing premature delivery, the large number of stillbirths is undoubted evidence of the widespread prevalence of venereal disease.

Amongst babies over seven days and under one month old, there were 878 deaths, equivalent to 16 per cent. of the total infantile mortality. Adding the number of deaths during the first week no fewer than 2,709 babies died during the first month. In other words, more than half the total infantile mortality occurred amongst babies under one month old. The principal causes of deaths were tetanus neonatorum 386 deaths, respiratory diseases 209 deaths, and congenital debility 147 deaths. Tetanus neonatorum is an entirely preventible disease due to "dirty midwifery." This is clearly shown by the fact that it is practically unknown amongst the thousands of babies delivered by the Corporation midwives. It is satisfactory to find that as a result of their operations, there has been a slight fall in the mortality from this disease. One is, I think, justified in coming to this conclusion, as none of the other causes of infantile mortality show any corresponding reduction.

Amongst babies one to two months old, the number of deaths was 441, the principal cause of death being respiratory diseases (bronchitis and broncho-pneumonia), which accounted for 251 deaths, or more than half the total.

At the next age-period, two to three months, a further decline in the number of deaths occurred. Here, again, respiratory diseases were the chief cause of death, there being 215 deaths from bronchitis and broncho-pneumonia out of a total of 333 deaths.

From three to six months of age 729 deaths, an average of 243 per month, occurred, whilst amongst infants six to twelve months old there were 1,154 deaths, or an average of 192 per month.

At both age-periods respiratory diseases were responsible for over half the total deaths. The high mortality from respiratory diseases has always been a striking feature of these returns. As babies, like all young warm-blooded animals, are very susceptible to changes of temperature, exposure when inadequately clothed (often naked) is probably an important factor in the etiology of these diseases. Of equal importance is overcrowding in damp, ill-ventilated rooms.

The comparatively low death-rate from diarrhœal diseases is in marked contrast. These diseases only account for 6 per cent. of the total infantile mortality. The number of deaths from these diseases gradually increases with the age of the infant, over two thirds of the deaths from diarrhœa occurring amongst children of from six to twelve months of age. This is due to the fact that breast-feeding is almost universal, and it is only as the child grows and the mother's milk is supplemented by artificial feeding that diarrhœal diseases become prevalent. In view of the notoriously dirty "sophisticated" milk sold in Calcutta, and the difficulty of keeping even clean milk fresh in the tropics, everybody in Calcutta boils their milk, the consumption of raw milk being almost unknown. This, I am convinced, is an important factor in the prevention of diarrhœal diseases amongst infants, in spite of a great deal of ignorance as to the vital necessity of storing milk in clean receptacles and protecting it from contamination after boiling.

The Birth-rate.

The number of births registered during the year was 18,212, or 20·1 per thousand, calculated on the total population. This is a slight improvement compared with the returns for 1921 and 1922, when only 17,308 and 17,349 births respectively were registered. As shown in previous reports, the only birth-rate of any value is that calculated on the number of women of child-bearing age. The peculiar constitution of the population in Calcutta with a large excess of males, and with a relatively small proportion of married women amongst the females renders a general birth-rate practically useless as an index of fertility or for the purpose of comparing local variations in the birth-rate. It will, of course, show local variations from year to year fairly accurately.

PRINCIPAL CAUSES OF DEATHS.

Cholera.

The epidemic of 1923 was one of the mildest ever recorded in Calcutta, the number of deaths registered as due to cholera being only 914 or 1·0 per thousand. The record year, 1917, with 866 deaths from cholera, only beats 1923 by a very narrow margin as the rate per thousand, calculated on the 1911 census population was ·96 per thousand, which very closely approximates the rate for this year. On studying the returns for the last thirty years, particularly when expressed graphically, it is quite clear that there is a fairly well-defined cycle which runs its course in about ten years. That is to say the annual recrudescences tend to increase in intensity year by year to a maximum and the decrease year by year to a minimum during this period. The terrible outbreak

of 1907, when there were 3,803 deaths from cholera was followed by a series of epidemics gradually lessening in severity right down to the mild epidemic of 1917. This was followed by a very severe epidemic in 1919, after which each year in turn saw an outbreak of less severity culminating in the extremely mild recrudescence of this year.

The epidemic of 1923 was remarkable for its late onset. Unlike previous epidemics, which usually show signs of lighting up in the cold weather, it was not till April that there were any indications of the approaching epidemic. This is even later than last year's epidemic, which started in March. This year's outbreak made little or no progress till May, when it rapidly reached its maximum and declined as rapidly. The acute phase of the epidemic only lasted three weeks. Although there was a slight terminal rise towards the end of June and the beginning of July, the height of the epidemic was over by the middle of June..

A very brief scrutiny of this year's list shows clearly that cholera in Calcutta is to a very great extent water-borne. Out of five wards in which cholera was most prevalent four are riparian. The only non-riparian ward is notorious for its numerous polluted tanks. Local explosive outbreaks in the vicinity of tanks are by no means rare in the suburban wards and are typical examples of water-borne disease. Fortunately, there is no epidemic disease which responds so rapidly to preventive measures, once the source of infection is traced. These local outbreaks can often be quickly controlled by chlorinating the infected tank and putting a police guard over it, and putting up extra standposts to increase the supply of filtered water.

The heavy incidence of the disease amongst Hindus, together with the fact that it is the wards bordering on the river and nullah which suffer most severely from cholera, is convincing evidence that cholera is water-borne, as the Hindu religion enjoins bathing in the river and nullah. Another, or rather the same source of danger in another form, is the unfiltered water supply. Millions of gallons of raw river water are distributed all over the city for flushing drains, waterclosets, &c. Unfortunately, particularly during the hot weather, it is freely used for domestic purposes. Unauthorized taps are to be found all over the city and unfiltered water is ladled out of reserve tanks or drawn off from ground hydrants. It is greatly to be regretted that the original scheme of Messrs. Moore and Bateman, which would have abolished this dangerous water supply *in toto*, was subsequently modified so as to perpetuate a system which is condemned in unqualified terms by every sanitarian I have met. Although I have always maintained that most of the cholera in Calcutta was water-borne, there are, of course, other sources of infection. Infection by direct contact is by no means infrequent owing to the carelessness and ignorance of friends and relatives. Soiled rags, &c., are thrown out into the street in a manner which is positively criminal. "Carriers" often apparently in good health and yet capable of infecting foodstuffs, &c., are another source of infection. They present a most difficult problem which will never be solved until a rigidly enforced system of notification, isolation in hospital and thorough bacteriological examination of all convalescents is in operation. Contamination of foodstuffs by dust and flies is another obvious source of infection, particularly the latter. It is unpleasant, to say the least of it, to think that every day throughout the year in Calcutta, there are 20,000 gumlas containing at least fifty tons of human fæces, lying exposed to the air, readily accessible to flies and polluting air, soil and water in their vicinity. I refer, of course, to the unsanitary service privies of which thousands remain in spite of the provision of sewers and water for flushing purposes. This grave menace to the public health is intensified by the disgusting methods of conservancy employed. Neither privy vault, gumla nor cesspit is ever properly cleansed. It, as appears likely from the very slow progress made in replacing them by connected privies, they are to remain for generations, a determined attempt should be made to improve them. Nothing short of the pail system and the abolition of the cesspit will be of any use. As the introduction of this system throughout the city will be a very expensive business, I am afraid there is little hope of it being taken up at present.

Lastly, a constant stream of infection is pouring into the city, and this includes a considerable number of imported cases of cholera. When these prove fatal prompt precautionary measures are taken, but when the cases recover the health department rarely receives any intimation and nothing is done to prevent the spread of infection.

It is hardly an exaggeration to say that in Calcutta at all events *cholera is essentially a disease of the Hindus.*

Out of a total cholera mortality of 914, no fewer than 792, or 86 per cent. of the total, occurred amongst Hindus. This is equivalent to a rate of 1·2 per thousand. Amongst Mohammedans, on the other hand, there were only 116 deaths, equal to 0·55 per thousand, whilst only four deaths occurred amongst Non-Asiatics and Anglo-Indians, and 2 deaths amongst Indian-Christians.

A rather unusual feature of this year's epidemic was the higher incidence amongst females, the death-rate per thousand beng 1·1 amongst females and only 0·97 per thousand amongst males. This is a reversal of the usual incidence.

The higher incidence amongst elderly women has always been a feature of these returns. It is unusual, however, to find any marked difference amongst young boys and girls. Young adult males invariably appear to be particularly susceptible. Broadly speaking, children (not infants) and old people are most susceptible.

Small-pox.

Another curiously localized outbreak of small-pox occurred during the beginning of the year. It was

much milder than the epidemic of 1922 and was even more strictly localized, being practically confined to the northern half of District I. The total number of deaths was only 157, or 0·17 per thousand, as compared with 1,450, or 0·49 per thousand in 1922.

The outbreak really began about the middle of February, when the number of deaths which had been fluctuating between five and seven per week rose to twelve. Even this slight rise was only maintained for a fortnight and then a fall occurred which lasted nearly a month. Towards the end of March a sudden rise to 19 deaths during the week ending March 31 occurred. This was the height of the epidemic, which rapidly subsided and was over by the second week of April.

This outbreak was almost entirely confined to District I, which returned 108 out of 157 deaths, or no less than 68 per cent. of the total.

A more detailed analysis of the returns reveals the astonishing fact that Wards I, II, III were responsible for 94 out of the 108 deaths in the district. Sporadic cases scattered over eleven other wards occurred chiefly in District II, where, altogether, twenty-three cases occurred. I suggested last year that the occurrence of these remarkable, localized outbreaks shortly after a severe and widespread epidemic such as occurred in 1920 might indicate a change in the epidemiology of small-pox or, at any rate, a temporary departure from the "cyclical" character hitherto such a feature of the disease in Calcutta. Possibly the vigorous vaccination campaign of 1918-20, during which about 300,000 persons were vaccinated, has had some effect in this direction. It has certainly made it difficult to push vaccination on a large scale. Local intensive vaccination, however, appears to have been a very effective measure. This resulted in each infected house being surrounded by a zone of dwellings every inmate of which had been revaccinated.

One of the most important functions of a health officer is intelligent anticipation of the probable course of events, particularly such profoundly disturbing ones as epidemics. In the case of small-pox, a study of the records of the last thirty-five years shows the following sequence of events:

(1) A "pre-epidemic" outbreak of moderate intensity.

(2) An explosive outbreak of great intensity.

(3) A non-epidemic interval of from one to four years which has never exceeded four years.

(4) During the latter part of the non-epidemic year preceding the "pre-epidemic" outbreak, a series of scattered sporadic cases occur, but unlike those in an ordinary non-epidemic year, they occur regularly week by week with hardly a break. This, in my experience, is a sure sign of the approach of a "pre-epidemic" outbreak to be followed by a severe and widespread epidemic the following year in 1921. At the time of writing the position is as follows. A severe outbreak in 1920 was followed by a typical non-epidemic year in 1921. In 1922 a most unexpected local outbreak occurred in Districts I and III. In 1923 an extremely mild local outbreak occurred in District I, *but the city was free from small-pox for several weeks during the latter half of the year.* Relying on this I confidently predicted that there would not be anything more than a mild local epidemic and possibly not even that in 1924. The probabilities are that the cold weather of 1924-25 will see a pre-epidemic outbreak of moderate intensity, but everything depends on the returns for September and October. Should a definite break of several weeks occur, however, it is just possible that the next epidemic may be postponed, but I am afraid this is hardly likely.

Plague.

The recrudescence of plague this year was a very mild one. There were only 77 deaths, or 0·08 per thousand, as compared with 144 deaths, or 0·15 per thousand last year. Last year's outbreak, following on two non-epidemic years, was an unpleasant reminder that conditions favourable to the spread of plague still flourish in Calcutta. Nevertheless, it is very satisfactory to be able to record another practically non-epidemic year. The outbreak began very late in the year. It was not till the last week of March that a slight rise in the mortality occurred, 9 deaths being recorded during the week. The following week the outbreak reached its height, 16 deaths occurring during the first week of April. By the middle of April the mortality was less than half, and though a slight terminal rise occurred towards the end of the month, the outbreak was completely over by May 12.

This outbreak was even more localized than that of 1922. Save for half a dozen sporadic cases in Districts III and IV it was wholly confined to Districts I and II, the former returning 40 and the latter 29 deaths out of a total of 77.

As previously noted, it is rather remarkable that localized outbreaks of plague rarely recur in the same locality two years running.

Measles.

Only 56 deaths were recorded as due to measles. This is equivalent to 0·06 per thousand and is the lowest rate recorded since 1915. It is satisfactory to find such a marked improvement this last two years as from 1916 to 1921 a series of epidemics occurred in which the mortality varied from 122 to 191. Prior to this series, there was a distinct tendency for rather severe outbreaks to occur followed by one or two non-epidemic years.

As in 1922 the outbreak this year commenced late and was over early. It began in March, the mortality rising to 12 or double that in February. It remained almost stationary in April and then subsided in May.

Enteric.

A further rise occurred in the number of deaths recorded as due to enteric from 413 or ·45 per thousand in 1922 to 460 or ·5 per thousand. It is

disappointing to find that the improvement in the returns in 1920 and 1921 has not been maintained. At the same time it is very difficult to decide how far the increase is real, in view of the extended application of serum tests in cases of prolonged fever.

The enteric mortality rate for the city was ·50 per thousand.

The fact that a large proportion of cases are treated at home without proper precautions against the spread of infection is undoubtedly responsible for a great deal of the enteric in Calcutta, either by direct contact or through the agency of dust and flies. "Carriers" play an important part in the spread of the disease, particularly in the case of outbreaks in schools, institutions, &c. This has been proved bacteriologically on more than one occasion. Salads and raw vegetables, which, as is well known, are usually grown in sewage-polluted soil, are another common source of infection, particularly amongst Europeans and Anglo-Indians.

Malaria.

The number of deaths recorded as due to malaria was 1,069, or 1·2 per thousand. This is almost identical with last year's figure of 1,081. These returns represent a steady improvement since 1920 and are the lowest recorded since 1917. As a correct diagnosis is often difficult it is advisable to consider the mortality from "other fevers" before coming to any conclusion as to the prevalence of malaria.

Although seasonal variations are not nearly so marked as one would expect, malarial fevers were distinctly more prevalent during the latter part of the year, i.e., after the rains. In January the mortality from malaria was 1·3 per thousand. A temporary fall to ·91 per thousand occurred in February. This curious fall in February affects practically all causes of death and is reflected in the general mortality returns. A rise to 1·4 per thousand in March was followed by a marked decline during the three months April to June, the death-rate falling to 75 per thousand in the latter month. During July and August another rise occurred to 1·3 per thousand again. This rise, save for a slight temporary decline in September, was maintained till the end of the year.

As in previous years, the death-rate amongst Mahomedans was much higher than amongst Hindus, the mortality rates being 2·6 and ·79 per thousand respectively. Although this is partly accounted for by the large Mahomedan population in the malarial wards, the difference is so marked as to suggest increased susceptibility. Amongst Indian Christians the mortality rate was ·66 and amongst non-Asiatics and Anglo-Indians only ·35 per thousand. Females were much more susceptible than males, the mortality rates per thousand being 1·6 and ·96 per thousand respectively. This is probably due to the women of the home being constantly exposed to insanitary surroundings from which the men escape for a certain number of hours every day. Young females, 10 to 15 years of age, appear to be particularly susceptible, the death-rate at this age-period being 2·7 per thousand.

Other Fevers.

The mortality from "other fevers" amounted to 2,151, or 2·4 per thousand, an increase compared with 1922, the corresponding figures being 1,801, or 2·0 per thousand. A severe and widespread epidemic of dengue occurred this year, and although the actual mortality from dengue was trifling it undoubtedly lowered the resistance of persons suffering from other diseases, particularly of this group.

This distribution confirms what has already been said about malaria and other fevers. Making every allowance for undiagnosed cases, such as malaria, kala-azar, enteric, &c., there are probably undifferentiated forms of fever still awaiting investigation by skilled research workers in tropical disease.

Dysentery and Diarrhœa.

The number of deaths from dysentery and diarrhœa was 2,734, or 3·0 per thousand, a slight increase compared with 1922, when 2,637 deaths, or 2·9 per thousand, occurred. The returns for 1922 and 1923 are a marked improvement over those for the preceding years 1918 to 1921. The diseases included under this heading are dysentery, diarrhœa, enteritis and puerperal diarrhœa or "sutika."

The returns for dysentery are almost identical with those for last year. A slight decline in puerperal diarrhœa is more than counterbalanced by a rise in the mortality from diarrhœa.

The mortality curve from this group of diseases shows a well-marked double curve, the first rise reaching its height in March, the second, a much larger one, in August. Starting with a death-rate of between 2·7 and 2·6 in January and February the mortality rose to 3·1 in March. It then declined gradually to a minimum of 2·1 in June. During July it rose rapidly and reached its maximum of 4·4 per thousand in August. The mortality remained high throughout September (3·9 per thousand). During the last quarter of the year it varied from 3·1 to 3·3 per thousand. The curves for 1922 and 1923 present a marked contrast to the average. Usually these diseases are most prevalent in January and December, when the mortality reaches its maximum, and least prevalent in June, when the lowest mortality occurs. The quinquennial average curve is V-shaped, with the point of the V in June and the limbs ending in January and December. The 1922 and 1923 curves show a rise and fall before and after the minimum in June.

Mahomedans with a death-rate of 3·3 per thousand had the highest rate of mortality. Then, rather unexpectedly, come Indian Christians, with a death-rate of 3·2 per thousand. Last year the mortality amongst Indian Christians was very little higher than amongst non-Asiatics, being only 2·2 per thousand. Amongst Hindus it was 3·0 per thousand, whilst amongst non-Asiatics and Anglo-Indians it was only 2·4 per thousand.

Colonial Medical Reports.—No. 184.—Calcutta (*contd.*).

The highest mortality rates occurred at the extremes of life. This is due to the fact that acute gastro-enteritis is common amongst infants and young children, and chronic diarrhœa is a disease of old age.

Females are particularly susceptible, the death-rate being 4·3 per thousand, as against only 2·4 per thousand amongst males.

Tuberculosis.

The number of deaths from tuberculosis was 2,089, or 2·3 per thousand, a slight decrease compared with 1922, when 2,216 deaths, equivalent to 2·4 per thousand, occurred. Slight though the decrease is, it is of great significance, as it is the first sign of improvement noted for many years. The returns for 1922 were actually the highest recorded since 1907. Between 1907-12 the number of deaths fluctuated from 1,950 to 2,200. From 1914-17, however, rapid movements set in, the deaths falling to 1,539 in 1917, a drop of 30 per cent. in four years. Then came the terrible series of epidemics of influenza. As I pointed out, at this time the disease, associated as it is with grave pulmonary complications, not only weakens the power of general resistance, but causes local damage to the respiratory system. Hence, persons already infected with tuberculosis readily succumb, latent infections light up, too, and fresh infections tend to occur more easily. The small but definite drop in the mortality from tubercle is, in my opinion, a clear indication that the effects of influenza on the public health have at length smouldered out.

This is not nearly so marked as one would expect in view of the prevalence of respiratory diseases in the cold season. In January the mortality rate was 2·5 per thousand. A temporary drop to 1·9 per thousand in February was followed by a recovery to 2·2 per thousand in March. The mortality was almost stationary in April and then suddenly rose to 2·8 per thousand in May. This was the highest rate recorded during the year. It then fell with equal rapidity to 2·1 per thousand in June, only to rise again to 2·5 per thousand in August. During September and October it varied from 2·3 to 2·4 per thousand, again declined to 2·1 per thousand in November and finally rose to 2·4 in December.

As in previous years, nearly the whole of the mortality from tuberculosis was due to pulmonary tuberculosis, this variety of the disease accounting for 1,967 deaths out of 2,089, or 94·2 per cent. of the total mortality from tuberculosis. There were only 122 deaths recorded as due to other forms of tuberculosis, of which 97 were from abdominal tuberculosis and 25 from tuberculosis of other organs. The extremely small proportion of all other forms of tubercle, i.e., tuberculosis of bones, joints and glands is, of course, due to the rarity of bovine tuberculosis in Bengal.

(N.B.—A careful examination of apparently healthy pigs will frequently reveal terbercular glands.)

The absence of bovine tuberculosis may not, however, be an altogether unmixed blessing.

It is so frequently the case that an absence or rarity of bovine tuberculosis co-exists with a very acute type of disease in man, that it is difficult to avoid the conclusion that the two phenomena are related. There can be no question that pulmonary tuberculosis in Calcutta runs a very rapid course. It is almost certain that the great majority of Indian patients die within a year of their first symptoms. This appears to be definitely related to the fact that, whereas only 2·3 per cent. of Indians examined post-mortem show signs of old tuberculosis infection, about 85 per cent. of cadavers examined in European countries contain such lesions.

In other words, minor infections, particularly those covered by tubercular milk, which appear to lead to the acquisition of resistance to acute pulmonary tuberculosis, are extremely rare in India. If these deductions are correct, a trial of pasteurized tubercular milk as a preventive seems indicated.

With bovine tuberculosis practically eliminated, the spread of tuberculosis in Calcutta is clearly from man to man through the agency of sputum. This is obvious to anyone conversant with the habits of the people. I allude, of course, to the very dangerous and objectionable habit of promiscuous expectoration so freely indulged in by all classes.

The causes of tuberculosis in Calcutta have been enumerated so often in these reports, and the progress made towards eliminating them is so slow, that one almost despairs of this veritable "white-plague" ever being brought under control. The chief causes are: (1) Insanitary housing conditions, with the evils of want of fresh air and sunlight intensified by overcrowding, and the retention of the purdah system in a densely populated city. (2) Ignorance and poverty, the former responsible for promiscuous spitting, the latter for under-feeding and bad housing.

The death-rate amongst Mahomedans was 2·8 per thousand as compared with 2·1 amongst Hindus. The difference is less marked than last year, when the rates were 3·2 and 2·2 per thousand respectively. Amongst Indian Christians it was 2·8, and amongst non-Asiatics and Anglo-Indians 2·6 per thousand, but these rates are calculated on a very small number of cases.

The saddest feature of the return is the high mortality rates amongst girls and young women.

Between the ages of 15 *and* 20 *years for every boy that dies of tuberculosis five girls die. What is the reason for this truly appalling state of affairs? Well, to put it brutally, these girls were suffocated behind the purdah.* It is, I am convinced, the retention of the purdah system in the densely populated gullies of a congested city that dooms so many young girls to an early death from tuberculosis. In less densely populated areas, where detached houses with compounds are possible, the purdah system could be adhered to without seriously affecting the health of the inmates of the zenana.

In a great city it is difficult to secure absolute privacy without shutting out light and air, as houses in narrow lanes and gullies are almost certain to be overlooked. Consequently, the zenana is usually situated in the inner portion of the house, ill-lighted and ill-ventilated, but effectually screened from the observation. Another very important factor in the ætiology of tuberculosis amongst girls and young women is early marriage, which subjects immature females to the strain of repeated pregnancies and prolonged periods of lactation. Lastly, I would again draw attention to the many thousands of cases of tuberculosis always present in Calcutta. This is apt to be overlooked, as these reports deal almost exclusively with deaths. At a very modest estimate, assuming that there are four or five living cases for each death registered, there are probably about 10,000 cases of tuberculosis in the city at any given time. In the great majority of cases no precautions are taken against the spread of infection. To speak plainly, thousands of consumptives are constantly spitting all over the place. Can one wonder at the prevalence of the white plague in Calcutta? An anti-tuberculosis scheme which included the appointment of a tuberculosis officer with eight assistant medical officers (for systematic house-to-house visiting), a dispensary and a publicity bureau has been approved by the health committee. Unfortunately, it could not be proceeded with owing to want of funds.

Respiratory Diseases.

After steadily dropping for three years, there has been a slight rise in the mortality from respiratory disease this year, the number of deaths being 6,124, or 6·7 per thousand, as compared with 5,814, or 6·5 per thousand, last year. Although slightly higher than last year, the returns for both 1922 and 1923 are much lower than those of 1918 to 1921. They are still, however, considerably above the pre-influenza average.

Several diseases are grouped under this heading, i.e., acute bronchitis, chronic bronchitis, broncho-pneumonia and pneumonia.

A slight increase in the number of deaths from acute bronchitis is compensated for by a decrease in the deaths from chronic bronchitis. Both pneumonia and broncho-pneumonia were slightly more prevalent, but the difference is small. The mortality from pneumonia is still very high, almost double the pre-influenza figure. Apparently a certain amount of influenza with pneumonia is being registered under this head.

The seasonal prevalence was much more normal this year, the highest mortality from respiratory diseases occurring, as in pre-influenza years, in January and December. Last year, the maximum death-rate occurred in March. This was obviously due to the inclusion of undiagnosed influenza. This year a similar but less marked rise also occurred in March, probably due to the same cause. In January the maximum mortality, 8·6 per thousand, occurred. A temporary fall to 6·5 per thousand in February was followed in March by a rise to 7·5 per thousand, the influenzal rise referred to above. It then fluctuated between 5·5 and 5·7 per thousand during April-July. In August it again rose, reaching 6·9 per thousand. After remaining at 6·4 per thousand during September and October the cold weather rise occurred, the mortality being 7·7 per thousand in November and 8·2 per thousand in December.

As in the case of tuberculosis, these diseases were much more prevalent in District III (death-rate 9·4 per thousand). In Districts I and II the death-rates were slightly below, in District IV slightly above that for the city (6·7 per thousand).

The two " black lists " correspond very closely. In both cases Hastings has been excluded, the high rate there being calculated on a comparatively small number of deaths. The manner in which suburban wards with large bustees are picked out year after year is very suggestive. The poor bustees dweller, ill-clad and poorly-fed, living in a damp hut, with mud floor and mud-plastered walls appears to be particularly susceptible to respiratory diseases. This is particularly the case in those areas which are not adequately drained and liable to flooding during the rains. Overcrowding and want of fresh air are also potent factors in the causation of respiratory disease. During the cold season an early morning visit to a bustee reveals every hut hermetically sealed, with filthy rags stuffed into every opening that cannot be closed otherwise.

As to age incidence, acute bronchitis is one of the principal causes of death amongst infants and young children. Out of 1,784 deaths from acute bronchitis, 1,401, or 78 per cent., occurred amongst infants, and 365, or 20 per cent., amongst children under five years of age.

Chronic bronchitis.—This is, of course, a disease from which old people suffer chiefly. Out of 1,281 deaths, no fewer than 775, or 60 per cent., occurred amongst persons 60 years of age and over.

Pneumonia.—The most susceptible age-periods appear to be 20-30 years and 30-40 years, 656 deaths out of a total of 1,748, or 37 per cent., occurring at these ages.

As a group, respiratory diseases were more prevalent amongst females than amongst males, the death-rates being 8·5 and 5·9 per thousand respectively. In the case of pneumonia, however, the exact opposite is found, the mortality amongst males being higher than amongst females.

The incidence of these diseases varies considerably amongst different sections of the community. The highest death-rate, 9·0 per thousand, was recorded amongst Mahomedans; the lowest, 3·9 per thousand, amongst non-Asiatics and Anglo-Indians. Amonst Hindus it was 6·2 and amongst Indian Christians 5·0 per thousand.

Influenza.

Only 371 deaths, equivalent to a death-rate of ·40 per thousand, were registered this year, a marked

decline compared with 1922, when 688 deaths, or ·75 per thousand, were recorded. As already noted, a certain proportion of cases are probably returned under the headings "respiratory diseases," "other fevers," &c., but, as the same error occurs every year, the annual returns are strictly comparable. From this point of view the steady decline from 4,115 deaths in 1918 to 371 deaths in 1923 is satisfactory, particularly as the mild recrudescence this year never assumed epidemic form.

The highest mortality, ·75 per thousand, occurred in January, and the lowest, ·18 per thousand, in June. From July-September it fluctuated between ·40 and ·50 and then declined during the last quarter of the year to ·30 per thousand. A very slight and evanescent rise in March occurred, but there was nothing like an epidemic.

The death-rate amongst Hindus was more than double that amongst Mahomedans, the mortality rates being ·48 and ·23 per thousand, respectively. As only four deaths were registered amongst the rest of the population it is useless giving death-rates. Males with a death-rate of ·47 per thousand were nearly twice as susceptible as females (death-rate ·26 per thousand). The highest mortality rates occurred during the age-periods 50-60 years and 60 years and over.

Kala-azar.

The mortality from kala-azar, which has been increasing steadily for several years, shows a sudden and very marked rise this year. The number of deaths recorded as due to kala-azar was no less than 501, or ·55 per thousand. This is nearly double the number registered last year (287, or ·31 per thousand) and almost five times the number recorded in 1919 (109, or ·12 per thousand). A very large proportion (217 cases, or 43·3 per cent. of the total) of the cases of kala-azar occurring in Calcutta are imported. Making every allowance for these, there seems no doubt that the number of indigenous cases is increasing, or, in other words, kala-azar is becoming more prevalent in Calcutta.

Broadly speaking, more deaths from kala-azar occurred in the latter half of the year, the highest mortality (·79 per thousand) occurring in September and the lowest in February (·31 per thousand). The increased prevalence after the rains rather suggest the inclusion of a certain number of cases of chronic malaria (quartan) in which great enlargement of the spleen occurs. On the other hand, as already noted, kala-azar is sometimes returned as malaria.

The incidence of kala-azar amongst different sections of the community is extremely interesting and in marked contrast to that of malaria and others fevers.

The relatively high death-rates amongst Indian Christians and Anglo-Indians for several years in succession appears to indicate either increased susceptibility or some special ætiological factor. As nothing definite is known as to the mode of spread, although it seems highly probably that some insect is the vector, all that can be done in the way of prevention is to provide facilities for the early diagnosis and treatment of cases. Every case cured is a one source of infection the less. In view of the remarkable cures affected by the intravenous injection of salts of antimony, it has been decided to open a large number of centres for treatment all over Calcutta. The scheme is now under consideration by the Public Health Standing Committee.

Dengue.

A severe and widespread epidemic of dengue swept through the city during the months of August, September and October. All classes of the community were affected, and it is estimated that from 30 to 40 per cent. of the population were attacked. In a city with a population of over 900,000 this means that there were about 300,000 cases. Only a few months before the onset of the epidemic the mosquito brigades were disbanded, in spite of my protest. Possibly the outbreak of dengue shortly after this retrograde step was only a coincidence. Whether there was any connection between the two events or not there can be no question that the health department were severely handicapped in dealing with the outbreak. A few inspectors and coolies were grudgingly sanctioned, but there was no time to organize the anti-mosquito work properly. Had the mosquito brigades been retained it would have been a simple matter to extend and enlarge an existing organization working under trained inspectors, and although the epidemic could not have been prevented, its ravages might, I think, have been checked to a certain extent. The epidemic appears to have started early in August. The first cases were reported from Kidderpore, but infection spread so rapidly and cases were reported from all parts of the city at such short intervals that it is almost impossible to trace the outbreak to any particular area. It reached its height in September, and though still very prevalent in October was obviously on the decline. Altogether 31 deaths were attributed to dengue. Of these 9 occurred in August, 14 in September and 8 in October. Assuming that my estimate of the number of cases is approximately correct, this is equivalent to a mortality rate of ·1 per thousand. Megaw (Dengue sand fly-fever problem I.M.G., September, 1923) gives a mortality range for dengue of from 0·1 per cent., the average being about ·05 per cent., or ·5 per thousand. The death-rate given above, though lower than the average, is within the range given by Megaw and is, I think, evidence of the correctness of the estimate made of the number of attacks.

Every possible clinical variety of the disease was seen during this epidemic. Mild cases with a few days fever and no other symptoms. Typical 3-day fever cases with severe pains, rash and secondary fever phase. Characteristic 7-day fever cases with and without pains, rash, &c. A remarkable feature of this outbreak was the number of cases in which severe pain in the vicinity of one or more joints persisted for weeks and even months. I give below

a very valuable and suggestive questionnaire issued by Lieut.-Col. Megaw, I.M.S., Director, School of Tropical Medicine, together with the answers submitted by the Health Department. These were based on roughly 2,000 cases seen by the M.O.'s of Dispensaries and the Assistant Sanitary Officers.

Questions regarding Dengue.

(1) How many cases have you seen?—Nearly 2,000.

(2) In your experience, have any races or classes been specially affected?—No.

(3) In your opinion, what percentage of the total population has suffered from the disease?—About 40 per cent.

(4) What proportion of your cases lasted—(*a*) Less than three days altogether?—30 per cent. (*b*) Less than three days, with a secondary fever about the fifth to the seventh day?—40 per cent. (*c*) Continuously for five to seven days?—25 per cent. (*d*) Longer than seven days?—5 per cent. to 10 per cent.

(5) In what proportion of the cases was a secondary rash seen (viz., a rash after the second day)?—In over 50 per cent.

(6) In what proportion of the cases was a relapse noticed?—In about 10 per cent.

(7) How long after the original attack did the relapses occur?—Please state (*a*) the shortest period—3 days. (*b*) the longest period—1 month. (*c*) the average period—1 week.

(8) In what proportion of cases did pains persist for a considerable time after the fall of the temperature?—30 per cent.

(9) Did you observe any features of the disease in which it differed from the ordinary dengue as described in the text-books? If so, please specify, giving figures to show the frequency of the feature referred to.—No.

(10) Did you observe any special complications of the disease? Please state these and the number of cases in which each occurred.—Acute intestinal trouble, dysenteric in character; 15 to 20 per cent. of cases had diarrhœa with malaria in a few instances. Arthritis noticed in 10 per cent. of cases. Enlarged lymphatic glands common. Recurrence of chronic ailments, such as rheumatism, asthma, pyorrhœa, &c.

(11) Did you observe any special sequelæ besides after-pains and debility? Please give details, stating the number of cases in which each occurred.—Œdema of feet, arthritis of large joints. Pharyngitis with enlarged tonsils. General glandular enlargement.

(12) In what proportion of the cases was swelling of the feet noticed after the disease?—In a few cases only.

(13) Did you observe any features in the spread of the disease which are opposed to the view that it is mosquito-borne?—No.

Epidemic Dropsy.

Four groups of cases of epidemic dropsy, three in Calcutta and one in Manicktola, occurred during the year.

Researches into the cause of epidemic dropsy are being carried on at the Tropical School of Medicine. Some very remarkable results have already been obtained and there is every reason to believe that Major Acton and his colleagues, working under Lieut.-Col. Megaw, will shortly solve the problem. The Health Department is working in close co-operation with the Tropical School, investigating local outbreaks, tracing the rice supply, securing samples of rice, examining the condition of storage, &c. At Lieut.-Col. Megaw's instance, a joint conference was held on September 21 at the Tropical School. The following is a brief summary of the conclusions arrived at:—

(1) Epidemic dropsy is undoubtedly caused by eating rice. It has never been known to occur amongst persons who do not eat rice.

(2) Recent experimental work at the Tropical School has shown that rice that has been stored for some time under certain conditions of temperature and moisture is attacked by a fungus or bacterium, and a toxin is formed which, when extracted and injected into animals, is capable of producing all the symptoms of the disease.

(3) The actual organism has not yet been isolated.

(4) It is not possible at this stage to assert that a particular sample of rice will cause epidemic dropsy without elaborate pharmacological tests on animals. That is to say, the seizure and destruction of rice suspected of causing epidemic dropsy as unfit for human food is hardly practicable at this stage.

(5) On the first appearance of symptoms of the disease absolute stoppage of rice and a mixed diet rich in vitamines, e.g., fresh milk, eggs, ghee, butter, fresh vegetables, fish, meat, &c., not only prevents the further development of the disease, but effects a perfect cure.

(6) As a preventive measure the use of freshly prepared rice is strongly recommended.

(7) An illustrated poster with the main facts given in simple language, has been drawn by Lieut.-Col. Megaw. It was decided that this should be published and circulated by the Health Department, particularly in markets and infected localities.

VACCINATION.

There were only 157 deaths from small-pox in 1923, against 450 in the previous year. This low mortality accounts for the heavy decrease in the total number of vaccinations done during the year under review, when altogether 48,062 persons were vaccinated, whereas the number of vaccinations was almost twice as much in the preceding year. As a result of long experience, it has been found that in a non-epidemic year it is practically impossible to push on vaccination vigorously, and the obvious reason is the stolid indifference of the people, who are not alive to the importance of vaccination as the only preventive measure against an attack of this terrible disease. Out of this total number (48,062), 17,223 were primary and 30,839 were re-vaccinations.

Colonial Medical Reports.—No. 184.—Calcutta (*contd.*).

SPECIAL WORK DONE AT THE LABORATORY.

Bacteriological.

Anti-typhoid Inoculations.—Towards the end of December, 1922, shortly after His Royal Highness the Prince of Wales left Calcutta, an explosive outbreak of typhoid fever occurred amongst the European population of the town and a few highly respectable gentlemen and ladies succumbed to it. Several suffered from it. Bacteriological examination of the blood of some of them was made in this laboratory, and positive Widal reaction to *Bacillus paratyphosus* was found in most of them. Announcement was made in the local newspapers inviting the public to have free prophylactic inoculations at the municipal laboratory, and a ready response was received from the European section. Scores of ladies and gentlemen visited the laboratory daily for the inoculation. Besides, in the case of public institutions like schools, colleges, offices and workshops, we used to visit them and gave them the inoculations at their own places. During January and part of February, altogether about 800 inoculations were performed and the epidemic was promptly controlled. Supply of lymph was obtained from the Government Laboratory at Kasauli. Thanks are due to the authorities there for their kindly supplying us with fresh vaccine promptly whenever a requisition was made. It is a matter of gratification to note that there was not a single case reported of having any untoward symptoms from any of the ladies or gentlemen who were inoculated by us with this vaccine.

Animal Vaccine Depot.

Throughout the year a good supply of glycerinated lymph was maintained at the depot and the stock in hand was more than double the quantity actually required.

The reserve stock of glycerinated vaccine lymph in hand on January 1, 1922, in our refrigerator was 108 large test-tubes full, and during the year 68 test-tubes were manufactured, which made a total of 176 test-tubes of vaccine virus. Each test-tube containing lymph sufficient to charge about 300 capillary tubes, three persons can be vaccinated with one capillary tube of lymph, so our reserve stock was sufficient for over 184,800 vaccinations.

At the commencement of the year there were 16 calves available for vaccination and 75 calves were hired during the year. Of these, 56 were utilized for the manufacture of lymph, 5 were returned as unfit for vaccination, leaving 14 calves available on December 31, 1923. So in all 72 (16 and 56) calves were vaccinated during the year; of these, 16 failed to yield vesicle pulp of good quality and the remaining 56 calves yielded 11,883 grains of vesicle pulp of excellent quality, which, being triturated with diluted glycerine, made 83,181 grains of glycerinated lymph. The average yield of vesicle pulp works out at 212·1 grains per calf. As usual, only healthy female calves with light coloured skin were selected for vaccination, as pigment is the sign of a coarse, tough skin and the vesicles produced are inferior to those on a soft, tender, non-pigmented skin. Male calves are not used for vaccination as they are apt to foul the vaccinated area of the abdomen with urine, &c. As a result of careful selection, there was no outbreak of "rinder pest" and foot-and-mouth disease amongst the calves, though the contractor supplied from the different bazaars.

The supply of calves is obtained from a contractor on a hire system. After vaccination, when the incisions are healed, the calves are returned to the contractor. After arrival the calves are kept under quarantine for ten days and daily carefully examined and any calf showing the slightest signs of disease is at once returned to the calf contractor.

From the quarantine shed healthy calves are removed to the tuberculin shed inside the depot and are tested against tuberculosis prior to vaccination. After allowing about a fortnight for recovery they are then vaccinated. During the interval they are carefully fed and attended to in order to get them into good condition, as calves in poor condition do not give vesicle pulp of good quality and the yield is scanty. In addition to the tuberculin test, the carcasses of all the calves are examined and certified free from tuberculosis by the veterinary assistant, Tangra.

The amount of glycerinated lymph issued from the depot to the public vaccination station of the city during the year was 31,825 capillary tubes, as compared with 52,141 in the previous year. Altogether 39,706 capillary tubes of glycerinated lymph were sent out from the depot during the year, against 64,341 in the previous year. This increase of 1923 was due to a mild outbreak of small-pox in District I. The total number of deaths from small-pox recorded during the year was 157, against 450 of the previous year. This being the third non-epidemic year, the people of the city did not care much to be vaccinated and so only 39,706 vaccine tubes had to be issued from the depot for vaccinations.

Only ripe lymph thoroughly cured by glycerine was sent out from the depot. The lymph of the depot maintained its customary high quality, which was tested by diverse trials at the depot prior to distribution. The bacteriological examination of the lymph at the municipal laboratory prior to distribution proved it as entirely free from pathogenic micro-organisms. Above all, the results of thousands of vaccinations performed every year afforded the best possible experimental proof of its potency and purity.

Analyst's Report on the Results of the Examination of River Water near points of Discharge of Septic Tank Effluents in February, 1923.

In July, 1922, the General Committee ordered an investigation into the quality of river water near Pulta Intake at different seasons of the year, with a view to finding out what effects, if any, are discernible by the discharge of effluents from various

sources into the river. In accordance with the above, a survey of the river was made in the month of August last, when 100 samples were taken and analysed. As a result of that investigation certain conclusions were tentatively drawn, which were embodied in a report and submitted to the General Committee. Another investigation on similar lines was started in February last, in which 107 samples of river water and effluents were taken from the river between Khardah and Samnagore. As before, the samples were collected in sets of three; the shore in the vicinity of discharge pipe of septic tank effluents, midstream, and the opposite shore. Samples were also collected from the Pulta Intake and also of the effluents from some of the septic tanks. For purposes of comparative study, the results have been classified into four groups, viz., (1) midstream, where the river is comparatively free from the influence of pollution entering from the shores; (2) shore or bathing ghat within 400 feet from the places where the effluents are discharged; (3) river water close to open drains; (4) effluents of groups of septic tanks.

The following general conclusions may be made from the results recorded therein:

(1) As noticed in August last, the midstream water is purer than water at either shore, although the February samples show distinct deterioration in quality, inasmuch as 32 per cent. of the samples showed 10 fæcal bacilli per c.c., compared with only 12 per cent. in August, and 4 per cent. showed 1,000 fæcal bacilli per c.c., whereas none of them had this number in August.

(2) The shore samples were decidedly inferior in quality to the midstream ones, as observed in August last. At the same time they were inferior in quality to the August samples.

(3) The Pulta intake water is almost as pure as midstream water, though the actual quality of the February samples is inferior to the August samples, inasmuch as in February 12·5 per cent. samples showed as many as 100 fæcal bacilli per c.c., whereas in August none of the samples reached this number.

(4) The results of examination of the septic tank effluents do not indicate any sign of improvement and are, if at all, only worse than the August samples. Of the February samples, 33 per cent. showed 1,000,000 fæcal bacilli per c.c.—a condition identical with that obtained from crude human fæces.

(5) The results of the mixture of effluents and river water, as in Khardah Khal, Titagur Khal and Ichapur Khal, are also worse than those obtained in August last.

It appears from the above that in the month of February, when the volume of water in the river is considerably less than in the rainy months of August, the amount of pollution is proportionately greater, the dilution being less.

The health officer reports as follows: Although the number of samples examined is small, I entirely agree with the conclusions drawn by the analyst. In investigations of this sort the method of taking samples and the technique employed are of great importance. In order to satisfy myself on these points I accompanied the analyst on one of his inspections. In all cases fair average samples without obvious gross pollution were taken. Most important of all dilutions and inoculation of media were rapidly carried out on the boat, thus avoiding the errors due to delay in sending samples to the laboratory.

The general deterioration in the quality of the river water, both midstream and in-shore, to which the analyst refers, was anticipated from our experience at Pulta. As he points out, it is almost certainly due to the diminished volume of water in the river. The most unsatisfactory feature of the report is the extremely bad results obtained from the examination of mill effluents. True, the number is small, but these results clearly show that the chlorination of septic tank effluents is not being carried out effectively. At Rishra a most interesting sight was seen, viz., effluent and almost boiling water being discharged into the river side by side. If chlorination is so difficult to enforce some system of sterilization by waste boiler water or steam seems worth a trial. On the opposite shore the contrast between the Titagur Khal, reeking of chlorine and the foul Khardah Khal only a few hundred yards away, was very striking. If a portion of the former could be diverted into the latter it would improve it considerably. In the letter of May 19, from the Secretary to the Government of Bengal, as the dates of collection of the samples referred to are not given, one is hardly in a position to compare results. As already noted above, our results appear to indicate that, save for a small percentage of cases, no attempt has been made to chlorinate the effluents. As regards the Kharda Khal Government may be requested to inform us of the measures taken by the local municipalities to put a stop to the gross fæcal pollution of this Khal. In the enclosure to the letter it is stated that improved chlorinating apparatus has been installed in thirty mills at the instance of the public health department and that the director of public health has arranged for the regular bacteriological examination of ninety samples of effluents every month.

The following conclusions may be drawn from the foregoing results:

(1) The midstream water is purer than water at either shore.

(2) The water near the shores shows marked signs of fæcal pollution.

(3) No marked improvement in the quality of shore water is evident since the last reports were submitted.

(4) The results of examination of septic tank effluents do not indicate that any appreciable improvement has been effected.

In the Government letter No. 50 T.P.H., dated May 10, 1923, it has been stated that an increased number of effluents are being sterilized before being discharged into the river. It seems probable that the factories from which my samples have been collected, have either not adopted the proper sterilization method or are not working it continuously.

In fact, my samples were confined to eight to ten factories situated on the river bank between Khardah and Titagur.

Even admitting that all of these factories adopt strict sterilization methods, still the continuous efficient working of these plants cannot be guaranteed. So, in view of the fact that, as years go on, the number of septic tanks on the river side will undoubtedly be on the increase and that pollution from these sources could not be avoided, even with the best of intentions, I would strongly recommend the advisability of considering the question of erecting a chlorinating plant at Pulta, not for working it throughout the year, but only at such times when its use would be considered necessary.

I would also urge the consideration of an Act for the Prevention of River Pollution on the same lines as the River Pollution Acts of England and America.

Colonial Medical Reports.—No. 185.—Trinidad and Tobago.

ADMINISTRATION REPORT OF THE SURGEON-GENERAL FOR THE YEAR 1924.

COLONIAL HOSPITAL, 1924.

Extern-Maternity Department.—305 women were delivered at their own homes during the year and 3,470 visits were paid by our nurse-midwives. Judging from the frequent calls made on our nurse-midwives, it is clear that their attendance is greatly appreciated by the poorer classes, and worked as it is in conjunction with our maternity ward it provides a very efficient maternity service which is bound to be of great benefit to mothers and infants alike.

Ambulance.—The ambulance has done good work during the year, but with the ever increasing work in this department it will soon become necessary to have another ambulance attached to the hospital so as to ensure a constant uninterrupted service for special cases. Perhaps some generous donor might thus help to carry on the good work for which we are indebted to the generosity of Mr. J. W. Stephens, the donor of No. 1 ambulance. We have to be thankful to Mrs. Arthur Wight for two very handsome surgical beds presented by her to the Colonial Hospital, which have greatly added to the comfort of patients and their attendant nurses.

A trolley with canopy for sunning bed-ridden patients has been presented by Mrs. Randolph Rust and a gramophone for the tuberculosis ward by Mrs. Lack. We are also grateful to many other friends of the institution who have regularly during the year provided small comforts for the patients in the shape of oranges and limes for the general wards and sweets and toys for the children. It is gratifying to see the general public thus taking an increased interest in our institution, which is only too grateful for any favours received.

In conclusion I wish to point out that outside of purely technical work the administration of a large institution like the Colonial Hospital with its many and increasing ramifications (such as Extern maternity service, ambulance service, health office, and venereal clinic) is a large undertaking which requires the services of a whole-time manager or secretary-manager, instead of being vested in the resident surgeon, who should be too absorbed in his own professional duties to be able to go into small details of discipline and administration.

Water Supply and Sanitary Arrangements.—The water supply has been good during the year. A new hot water system for the operation room, maternity and acute wards has been devised, and will, I hope, soon be established.

The sanitary arrangements are good and up to date.

Diet.—The dietary has been satisfactory, the new kitchen range has effected a much needed improvement in the cooking.

Accommodation.—The daily average of patients has been exactly the same as the authorized number of beds, namely, 340. This does not mean that there has been no overcrowding—at certain seasons of the year the number of admissions cannot be accommodated, and in spite of all our efforts the chronic wards become uncomfortably congested. This is due to the insufficient accommodation at the House of Refuge necessitating our keeping at hospital numerous cases which should be accommodated there. I have on frequent occasions called attention to this, but with no improvement; the House of Refuge, which is in reality a house for the aged or disabled poor and therefore entirely restricted to chronic cases, is never called upon to make room for an extra inmate, yet the Colonial Hospital, an institution primarily meant for acute cases, must admit destitute poor cases even though the floor beds in a ward make circulation therein a matter of difficulty. This, I think, ought to be rectified, and would ultimately prove economical, the cost per head of a patient in the Colonial Hospital being considerably in excess of the cost of a patient at the House of Refuge.

The greatest number of patients in hospital on any one day was 371, the smallest number 302. The chief diseases treated were: Enteric fever, malarial fever, gonorrhœa and syphilis, pulmonary tuberculosis, chronic nephritis, enlarged tonsils and adenoids, ulcers, ankylostomiasis, hernia, pneumonia, bronchitis, diarrhœa and dysentery.

There has been a big increase of enteric fever with a comparatively low mortality.

Malarial fever also shows a marked increase, the large majority of these cases come in from the country districts; very few originating in the city of

Port-of-Spain. On the other hand, there has been an appreciable fall in pulmonary and intestinal diseases, no doubt due to the more seasonable weather prevailing.

The total number of cases treated as in-patients during the year was 5,999 and the number of deaths 867. If cases, both medical and surgical, were admitted in an earlier stage of their disease the case mortality of the hospital would be very much lower than at present, and the help of the general practitioner and also of the public would be much appreciated by the hospital staff in this matter.

The number of casualties treated in the surgery, exclusive of in-patients, was 2,991.

Surgical Operations.—There were 1,703 operations performed during the year, with 50 deaths.

San Fernando Hospital, 1924.

Water, &c.—The water supply was adequate during the latter half of the year, but some difficulty was experienced during the dry season. The pail system is in use.

Diet.—The diet is satisfactory and also the cooking. The supply of fresh milk was increased and the greater part of this is now obtained from the Government Farm. A few additions to the diets were authorized during the year and much appreciated by the patients.

Accommodation.—The hospital contains 153 beds, of which 20 are reserved for tuberculosis cases, 7 for maternity cases, and 3 for private room patients. 3,311 patients were treated in the wards. 111 patients were treated in the maternity ward. 93 patients were attended to by the Extern midwife and 915 visits made. 975 patients were treated in the surgery exclusive of patients suffering from diseases of the eye, ear, nose and throat, and diseases of women, of which unfortunately no record was kept.

The Venereal Clinic was opened daily for the free treatment of venereal diseases.

The following diseases were treated: Syphilis, gonorrhœa, granuloma, and yaws.

The chief diseases treated in hospital were: Ankylostomiasis, syphilis, malaria, dysentery, chronic nephritis, bronchitis, phthisis, pneumonia and enteric fever.

Lunatic Asylum, 1924.

Admissions, Discharges, Deaths.—Among the admissions, which were fewer than in the preceding year, cases of mania greatly exceeded any other form of mental disorder. A welcome feature was the larger number who were brought under institutional treatment at an early stage of their illness, affording a hopeful prospect of useful recovery.

Fifteen (10 per cent.) of the admissions made a good recovery and were discharged before the end of the year. The recovery rate was 36 per cent., as compared with 27 per cent. in the preceding year. In spite of the difficulty of obtaining reliable histories, hereditary instability was clearly the most frequent predisposing cause.

The deaths were fewer than in 1923, and included 12 from tuberculosis, the bugbear of asylums. Enteric fever caused five deaths. The three remaining cases of general paralysis of the insane, a rare form of mental disease in this asylum, died during the year. The percentage of deaths on the average number resident was 12·3.

Accommodation.—There were at the end of the year under review 46 vacancies for males and 30 for females. The total number under treatment was 800, and the average number resident 649.

Buildings, Water Supply.—The buildings were maintained in good order. The water supply was ample.

Employment.—The usual high percentage of inmates employed was well maintained, and work of a considerable economic value was accomplished throughout the institution. The value of the produce from the grounds was not up to the average owing to unfavourable weather during the greater part of the year.

Health of the Institution.—Typhoid fever continued to appear sporadically among the inmates, six females and three males being affected. No fresh case has occurred since October. For some years past the incidence of dysentery has been steadily declining, and the few cases during the year were of a particularly mild type.

Staff.—The conduct of the staff was generally good, in spite of the resignation and retirement of several of the senior employees having greatly increased the proportion of probationers on the staff.

Leper Asylum, Cocorite.

(*A*). The general accommodation is ample and consists of one large building, two churches, one day room, twelve wards, one laundry, two linen rooms, one mortuary and one incinerator. The staff consists of one resident superintendent, one dispenser, 17 nurses, one steward and 23 employees. The conduct in general of the staff has been satisfactory, and I should like to add that the staff as a whole deserve not only the gratitude of the inmates but of the public in general for the devotion, self-sacrifice and untiring energy towards the care and welfare of the inmates and not less of the institution under their care and management. Quarters are provided for the resident superintendent, the sisters of the nursing staff, and the steward.

(*B*). The buildings are not in very good condition —the institution as a whole needs thorough repair and repainting.

(*C*). The water supply is ample and of good quality. The drainage is satisfactory and the incinerator works satisfactorily.

(*D*). The diet is good.

(*E*). Twelve wards are provided for the accommodation of patients—six male and six female. Their condition is referred to in paragraph *B*.

(*F*). The chief diseases treated are leprosy in its various forms, with complications of tuberculosis, hookworm, and general systemic ailments.

Colonial Medical Reports.—No. 186.—Bengal.

MALARIA AND AGRICULTURE IN BENGAL: HOW TO REDUCE MALARIA IN BENGAL BY IRRIGATION.

By CHAS. A. BENTLEY, M.B., D.P.H., D.T.M.& H., K.H.G., F.S.S.

Director of Public Health, Bengal.

Malaria and Agriculture.

A close association has always been recognized between malaria and agricultural conditions, and it has long been known that a greatly increased prevalence of the disease almost invariably accompanies the decay of agriculture and the decline of cultivation.

The cultivation of the soil in relation to malaria is, therefore, of overwhelming importance, and with good reason, for the question of rural malaria is so closely bound up with that of agriculture that the one cannot be properly understood without some knowledge of the other. Moreover, there are grounds for believing that the mitigation and prevention of malaria in the rural districts of Bengal, a problem for which no adequate solution has yet been suggested, may eventually be secured by measures designed as much for preserving or restoring agricultural prosperity as for directly dealing with malaria.

In Bengal, where the bulk of the people are dependent upon agriculture, low death-rates and good health accompany agricultural prosperity, and high mortality and bad health on the contrary are as clearly associated with evidence of agricultural deterioration

For many years past, the growth of the population in Western and Central Bengal has undergone a serious check owing to diminished birth-rates and excessive mortality. The factors mainly responsible for this condition are malaria and economic stress resulting from agricultural decline. These factors are known to be specially destructive of child life, and the proportion of children under ten in the different natural divisions reflects their influence very clearly in the case of both Western and Central Bengal.

The lower death-rate, higher birth-rate and more rapid growth of population in Eastern Bengal are due to the relatively better heath and greater agricultural prosperity of this natural division.

The lessened incidence of malaria in Eastern Bengal is the main cause of its better health. Malarial fever is at least three times more prevalent in Northern Bengal, four times more prevalent in Central Bengal and five times more prevalent than in Western Bengal.

As regards agricultural prosperity, we find that during the decade 1901-1911, agricultural conditions were much more favourable in Eastern Bengal than elsewhere. For example, whereas the outturn of the principal food crops fell short of the normal by 21·8 per cent. in Western Bengal, 21 per cent. in Central Bengal and 12 per cent. in Northern Bengal, the deficiency in Eastern Bengal was only 7·2 per cent. Land was also more widely cultivated in Eastern Bengal and the proportion of fallows very much less than elsewhere.

The factors which mainly determine the outturn of crops, thus governing the agricultural prosperity of different areas in Bengal, are: (1) the relative fertility of the soil, (2) adequate and seasonal rainfall, and (3) liability to enriching inundations with silt-bearing river water. Two of these factors—rainfall and inundations—also exert an important influence upon malaria, heavy rainfall and wiwdespread inundation of the land surface tending to check the breeding of anopheles mosquitoes, whereas short rainfall and scanty inundations favour their increase. Hence the relative prevalence of malaria is largely influenced by the same conditions which determine a good or a bad harvest.

The soil in Eastern Bengal is so much more fertile than that in the other natural divisions that land rarely needs to lie fallow.

Eastern Bengal.—The causes both of the perennial fruitfulness of Eastern Bengal and the relative infertility of the western portion of the delta are well known. We read in the statistical account of Bengal that, "lands adjacent to rivers, or watered by them, do not require manure, but other lands do," "that low lands which are continually flooded do not require to lie fallow in order to preserve their fertility," and that in Eastern Bengal, "rotation of crops is nowhere practised, nor can it be said to be required, as by far the greater part of the arable land is each year refreshed with a new deposit of river mud." Both the *Imperial Gazetteer of India* and the various census reports point out that Eastern Bengal enjoys advantages for which it would be difficult to find a parallel in any other part of India.

"The rainfall is abundant, is usually well-distributed and is never known to fail. The land of the delta is enriched by yearly deposits of silt. The climate, the soil and the river system are all alike favourable to cultivation.

"In its course through Bengal, the Ganges rolls majestically down to the sea in a bountiful stream. . . . .Embankments are seldom required to restrain its inundations, for the alluvial deposits, which it spills over its banks year by year, affords the fields a top dressing of inexhaustible fertility. The natural overflow of the periodic inundation is sufficient to supply a soil which receives in addition a heavy rainfall, and this natural overflow is allowed to find its own lines of drainage. The plains of Eastern Bengal, watered by the Brahmaputra, yield abun-

dant crops of rice, jute and mustard, year after year, without undergoing any visible exhaustion.

"The gneissis, laterite, and old alluvial soils are alike mainly dependent upon artificial manures to maintain their fertility, whereas the recent alluvium is periodically fertilized by fresh deposits of silt from the overflowing rivers. The latter process is most active in Eastern Bengal, in the deltas of the Ganges and the Brahmaputra, whose waters possess the fertilizing properties of the Nile."

Central Bengal.—While the astonishing fruitfulness of Eastern Bengal is thus ascribed to the periodic flooding of the country, the relative impoverishment of Central Bengal is admittedly due to the cessation of the similar fertilizing inundations which that area used once to enjoy.

The Bengal census report of 1901 refers to the condition of Central Bengal in the following words:

"Central Bengal, which is bounded on the west by the Bhagirathi, on the north by the Padma, and on the east by the Madhumati, was formerly the Ganges delta, but it has been gradually raised above flood level, and the great rivers which formerly flowed through it, depositing their fertilizing silt, yielding an ample supply of wholesome drinking water, and draining it, having shrunk to insignificance. Their mouths have been silted up and their beds are often higher than the surround-country, which they are no longer able to drain. The country has become less healthy, and is far less fertile than it was formerly.

Northern Bengal.—A portion of Northern Bengal enjoys advantages similar to those which have brought prosperity to Eastern Bengal. But in the centre and the west of the division the land is too high for inundations and in Rajshahi and part of Pabna they have also practically ceased.

It may be remarked that of late years complaints have been made regarding the silting up of the rivers in Malda, and the author, when touring the district, was told by a number of cultivators that fertilizing inundations with river water are now less common than formerly.

Eastern Bengal and certain parts of Northern Bengal owe their agricultural pre-eminence to the fact that they are each year inundated by the spill waters of the great rivers, which, besides affording an ample supply of moisture for the purposes of cultivation, bring with them a rich supply of silt, which is deposited upon the surface of the country, thereby renewing its fertility, and it is the same agency which keeps these areas almost free of malaria.

Central Bengal.—Agricultural conditions in the western portions of the Gangetic delta make a very poor showing, compared with those in the east. Take the cases of Nadia, Murshidabad and Jessore; as for back as 1881 the report of the Nadia Fever Commission remarks:

"*Diminished fertility of the soil in Nadia.*—There is a consensus of opinion among Europeans and Natives that, except in the low lands used for the rice crop reaped in the cold weather, there is a distinct decrease in fertility of the soil of Nadia. Considering that no land except that used for sugar-cane and tobacco is ever manured, and that the Ganges floods, which are so fertilizing, are shut out by the embankments of the rivers, it is not to be wondered at that gradually the soil should become partially exhausted."

Even earlier than this time, the effect of diminished inundations had become apparent, as may be seen from the passage quoted below, which occurs in a letter from the indigo-planters, published in the Supplement to the *Calcutta Gazette* of 1864 in quite another connection.

"In the low rich land affected by the inundation the *raiyats* go on year after year sowing their crops without experiencing any great deterioration. On the high lands depending on the elevation of the soil, and where not enriched by annual deposits, the *raiyat* merely extracts what he can without returning anything to it in the way of manure, and consequently this soil becomes exhausted, forcing them to let the land remain fallow for one or more years."

The Effect of Embankments in causing Malaria and Agricultural Decline.

Deltas naturally free of Malaria.—Contrary to what is often assumed and even definitely stated in the older medical text-books, deltaic swamps and the so-called "bottom lands" adjacent to large rivers are as a rule comparatively healthy and naturally free from a serious amount of malaria.

The freedom from malaria enjoyed by the delta of the Nile was mentioned by Strabo over two thousand years ago. And the same author remarked of Ravenna, a city in the delta of the Po-Reno, that like Alexandria, though surrounded by swamps, it was free of marsh fever. Ravenna remained healthy for a long period. Thus Vetruvio cited it as an example of a well-situated and healthy city; and Chig quotes Marzia as praising its salubrious air while complaining of the incessant croaking of the frogs. Ultimately, however, partly as the result of natural causes and partly owing to artificial changes, Ravenna became very malarious and has remained so for many centuries. The big deltas of China are known to be comparatively non-malarious. The troops from India encamped on the muddy flats of the Peiho and Peithang rivers in 1860 enjoyed an extraordinary immunity from malaria and even those regiments which had suffered severely in India were exempt. "Even the depressed oriental race of China," says Wilson, "seems never to have had a difficulty in mastering the great problems which the necessity for the subjugation of rivers forces on civilized man; the Chinese waters have been turned to the most profitable account; their deltas seem healthy and abound with life . . Agriculture is said to be perfect." The singular immunity of certain deltas from serious malaria has been reported from many other parts of Asia.

The Great Dismal Swamp in Florida has long been considered remarkable owing to the fact that malaria is rarely or never contracted there. And although some parts of the Mississippi delta are malarious other portions of swampy littoral are reported to be

healthy. The deltas of the big rivers in South America have long been known to be relatively non-malarious. Humboldt, Bates and Galt all record the comparative freedom from malaria observable in the delta of the Amazon in contradistinction to the river valleys, some of which are appallingly unhealthy.

Malaria is absent from the pampas of the River Plate and the delta of the Parana River. Mantegazza (1858-62), confirming the previous reports of Wilson and Brunel (1842), states of the banks of the Rio-de-la-Plata that "paludal fevers are nowhere known."

The deltas of some of the large African rivers are as yet comparatively free of malaria.

Daniels records in his report to the Royal Society that he was unable to find anopheles mosquitoes in the swamps at the mouth of the Zambesi; and he mentions of a town at the mouth of the river that "Chinde now has the reputation of being a healthy place of residence." As regards the delta of the Niger, it may be mentioned that Annett, Dutton and Elliott, the members of the Malaria Expedition to Nigeria, spoke of Brass, which is in the delta, as "a comparatively healthy district."

In Sumatra, the low-lying areas along the flat banks of the Palembong river enjoy a comparative immunity from malaria fever. And the recent investigations of Terburgh show that there is little malaria at Palembong, Sourabaya, Padang and Banda. In Borneo, at Sambas, few cases of fever are to be met with in the marshy plains. Among 2,385 children examined in this situation only 78 or 3·2 per cent. showed splenic enlargement, whereas in a neighbouring hill-station 441 among 534 or 82·5 per cent had enlarged spleens.

Immunity from malaria is reported from the Godavari and Kishna deltas in Madras. The dispensary returns from these two districts show that during 1918 among a total of 449,614 and 363,107 out-patients admitted for treatment in these two districts only 5·5 and 3·1 per cent., respectively, suffered from malaria. In 1855, Baird Smith in his report on Irrigation in Southern India, remarked upon the freedom from malaria enjoyed by the delta tracts of the Cauvari and Colaroon Rivers, which have been irrigated for hundreds of years by flow irrigation. This is borne out by the dispensary returns for 1918, which show only 11,237 cases of malaria among 589,726 patients admitted for treatment, giving an astonishingly low fever index of only 1·9 per cent. The delta of the Mahanadi river in Orissa, although not quite so free of malaria as the Madras deltas just mentioned, also enjoys when compared with Bengal a relative immunity from the disease. The dispensary reports for 1919 show that malaria cases represented only 11 per cent. of the total admissions for treatment, which compares favourably with 25 per cent., the figure for Bengal as a whole, and 50 per cent., that of many of the more unhealthy areas.

Deltas may become intensely malarious.—Deltaic areas, though naturally healthy so long as they are not interfered with, are yet almost always potentially malarious. Besides the case of Ravenna, numerous instances may be quoted of deltas that have become notorious on account of the prevalence of malaria. For example, speaking of the Tuscan Maremma, a malarious tract watered by the Cecina Corma, Pecora, Bruna, Ombrone and Albegna rivers, Baird Smith remarks:

"It is to the disorganization of these rivers that the ruin of a tract, which nature has endowed with the richest of soils and the mildest of climates. . . with plains affording abundant pasture and fit for any kind of cultivation, is chiefly to be attributed."

India, too, can show examples of once prosperous delta areas sinking into a state of decay through agricultural decline and epidemic malaria and then being restored once again to a condition of health and prosperity by the reorganization of their river systems. The Tanjore and the Rajahmandry districts in Madras, which have both passed through these experiences within the last century, are striking instances. Much of Lower Bengal, on the other hand, is suffering at the present moment from disastrous changes similar to those which once threatened the existence of the more favoured deltas just mentioned. In this case the disorganization of the rivers has been largely brought about or at least greatly hastened by human interference.

Bengal a Country of Deltas.—An examination of Bengal and its river systems shows that a very large proportion of the province is deltaic. The total area of the province is now 84,092 square miles, or, deducting the States of Cooch Behar and Hill Tippera, 78,699 square miles. Of this area, more than 75 per cent. is delta. The joint deltas of the Ganges and Brahmaputra alone cover from 50,000 to 60,000 square miles, and there are many smaller streams which possess deltas of not inconsiderable size.

Owing to their extraordinary fertility, deltaic areas tend to become densely populated and are relatively healthy and very prosperous as long as they remain subject to normal inundations with the spill water from their rivers. But changes tend to occur from time to time in deltaic rivers, and such changes are apt to be followed by consequences serious alike to the health and prosperity of the areas affected. Changes in delta channels are often due to natural causes, but there is reason to believe that many of those that have occurred in the delta channels of Lower Bengal during the past sixty years are of human origin, and have followed the embankment of the country for the purpose of improved communications." In this connection, too, it is significant that reports have come to hand quite recently of the serious extension of malaria in the delta tracts of Cochin China, owing, it is suggested, to the more rapid spread of infection that has followed upon the improvement of communications. But the improvement of communications almost invariably means the construction of railways and roads; which in deltaic areas entails the multiplication of embankments; and these embankments, unless specially designed to avoid such results, eventually lead to the disorganzation of

the river systems; the dislocation of natural flush and drainage, and other disastrous consequences, as agricultural decline, depopulation and epidemic malaria, such as have occurred during the last sixty years in Lower Bengal.

In the deltaic portions of Bengal cultivable land, ordinarily subject to inundation with river water, never requires to lie fallow, whereas other lands do. Fallows, therefore, may be taken as an index of soil impoverishment. Embankments prevent inundation by river water.

In proportion to the cultivated area, fallow land is five times as common in both Western and Northern Bengal than in Eastern Bengal, and in Central Bengal the proportion of fallow land is just ten times as great as that in Eastern Bengal. In view of the facts stated, the multiplication of railways and roads in the deltaic portions of Bengal is to be regarded with grave misgivings. The embankments exert a most deleterious effect upon the fertility of the soil, thus causing a serious decline in the agricultural production of the areas they serve. Roads and railways afford, it is true, excellent facilities for the transport of goods and especially for the rapid transit of passengers. But these advantages may be too dearly purchased, if the construction of the necessary embankments brings about, as it may do, in course of time a 50 per cent. reduction in the agricultural outturn of whole districts, turning healthy areas into hot-beds of malaria and eventually leading perhaps to the destruction of nearly half their total population.

Recent observations have shown on numerous occasions that, following the construction of embankments, there is a very great local extension of malaria on both sides of the embankment, accompanied by a rise in the local mortality, an increase in the proportion of fever cases and fever deaths and a rise in the spleen index. Changes of this kind have been noted and specially reported on in detail in the case of the railway from Katwa to Sahibganj, in Birbhum and Murshidabad, in the case of embankments connected with the Sara-Bridge and in the case of the Sara-Sirajganj Railway. A considerable rise in the fever index has also been noted in the case of recent railway construction in Mymensingh.

The occurrence of outbreaks of malaria in association with the construction of embankments has never been disputed, and the observation in regard to the sudden increase of the spleen index in the neighbourhood of these embankments is conclusive. But the manner in which embankments bring about this admitted increase of malaria requires to be made clear, in order that adequate steps may be taken to remedy the condition and to prevent the further extension of the evil.

The Burdwan Fever Epidemic.—Enough has been stated to show that the embanking of the delta tracts of Bengal, whether for roads, for railways or for flood prevention, is almost invariably followed by the most disastrous consequences alike to health and to agriculture. This view is greatly strengthened by a consideration of the circumstances which led to the great Burdwan fever epidemic of sixty years ago. The special committee appointed in 1863 to investigate this epidemic fever, reported in 1864 that the area first affected by the disease had recently ceased to be inundated and enriched by flood water from the rivers.

A little earlier, Dr. Elliott, in a report on the "Epidemic Remittent and Intermittent Fever occurring in parts of Burdwan and Nadia Divisions," remarked that one of the principal causes of the epidemic was want of cultivation. He had almost invariably observed that the epidemic appeared first and was most virulent in the oldest and most populous villages, the lands in and around which had gone out of cultivation. Thus, while the fever committee showed that the fever was associated with relative infertility of the soil owing to lack of inundations, Dr. Elliott commented on the associated lack of cultivation. The one statement corroborates the other, for, as is well-known, lack of fertility leads to lack of cultivation.

The Effect of Embankments on Malaria.

How Embankments increase Malaria.—The increase of malaria that almost invariably follows the embanking of deltaic areas in Bengal is due to the interaction of a number of factors, most of which have a definite bearing upon the breeding of anopheles mosquitoes. The construction of embankments themselves leads, in the first place, to a great amount of excavation and the resulting borrow-pits afford additional breeding places for anopheles. But, except in rare instances, excavations of this kind are of relatively small importance, because enormous numbers of dobas and ditches and excavations of all kinds already exist in the immediate neighbourhood of all villages situated in deltaic areas. This is owing to the fact that every house has to be provided with a high earthen plinth raised well above the level of the inundation. In areas also where the houses are built of mud, as is the case in many parts of Central Bengal, building operations always result in extensive excavations. Hence villages in the delta tracts are all potentially malarious. But, ordinarily, however numerous and extensive the excavations of borrow-pits on a village site may be, they do not give rise to malaria so long as the greater part of the surface of the country is submerged by floods of river water during each wet season, for in these circumstances each hollow and depression is temporarily obliterated, so that anopheles mosquitoes cannot use them as breeding places. But should inundation cease or be prevented, every hollow which can hold rain water becomes a dangerous breeding place, and anopheles mosquitoes can thus multiply unchecked. Observations show that during the rainy season anopheles mosquitoes of various species, known to carry malaria, often occur in enormous numbers in the villages situated in embanked deltaic areas, whereas these insects are usually present in very scanty numbers at the same time of the year in areas that are actually inundated with river water.

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INDEX TO VOL. XXIX.

JANUARY 1 to DECEMBER 15, 1926.

INDEX OF AUTHORS.

ANDREWS, W. H., D.Sc., M.R.C.V.S., BAYLIS, H. A., M.A., D.Sc., and SHEATHER, A. L., D.Sc., M.R.C.V.S.—Further experiments with *Gongylonema* of cattle, 194, 346

ANNECKE, S., M.A., M.B., D.P.H., and THOMSON, JOHN GORDON, M.A., M.B., Ch.B.—Observations on pathology of central nervous system in malignant tertian malaria, with remarks on certain clinical phenomena, 343

BAYLIS, H. A., M.A., D.Sc.—New species of *Hepaticola* (nematoda) from rat's stomach, 226

—— SHEATHER, A. L., D.Sc., M.R.C.V.S., and ANDREWS, W. H., D.Sc., M.R.C.V.S.—Further experiments with *Gongylonema* of cattle, 194, 346

BAYON, H. P.—Virus diseases of bacteria, plants and vertebrates, 17

BELLARD, E. P. DE.—Subacute inguinal poradenitis, or climatic bubo, 103

BHATTACHARYYA, N., M.B.Cal.—Brief note on morphology, cultural characters and biochemical reactions of *Vibriothrix zeylanica* Castellani, 371

BLAIR, K. G., B.Sc., F.E.S.—Entomological notes with cancer field commission in Trentino, 1925, 294

BONNE, C.—Cancer of stomach of wild rat and infection with nematode worm, *Hepaticola gastrica*, Baylis, 1925, 288

BRADLEY, G. H., and KING, W. V.—Airplane dusting in control of malaria mosquitoes, 311

CASTELLANI, ALDO, C.M.G., M.D., F.R.C.P.—Bronchospirochætosis, 360

—— Observations on importance of symbiosis or close association of different species of organisms in production of certain biochemical phenomena and in causation of certain diseases and certain symptoms of disease, 217

—— and TAYLOR, F. E., M.D., F.R.C.S., D.P.H.—Further observations on a mycological method to identify various sugars and other carbon compounds, 201

CAWSTON, F. G., M.D.Cantab.—Bilharzia problem in South Africa, 177

—— Environmental influences which favour development and spread of bilharzia parasite in South Africa. Food supply of "Physopsis," 89

CEVEY, F., M.D.,—Search for more efficient prophylaxis against tuberculosis, 53

CHEATLE, Sir G. LENTHAL, K.C.B., C.V.O., F.R.C.S.—Examination of cancerous and other tumours in animals collected by Dr. Sambon during his recent researches, 298

CHYURLIA, N., M.D.—Notes on case of bronchomycosis, 145

COLES, A. C., M.D., D.Sc., F.R.S.Edin., M.R.C.P.Lond.—Leptospira: methods of examination: new habitat of free-living forms, 170

COPLANS, MYER, D.S.O., O.B.E., M.D.—Studies in vaccinia variolæ, 122, 133

CORSON, J. F.—Note on further experiences of use of Panama hat in Tropical Africa, 303

—— Protection of the head against the sun's rays in Tropical Africa, 2

CROUCH, H. A., M.C., M.R.C.S., L.R.C.P., and WHITEHEAD, N. T., M.C., M.B., Major R.A.M.C.—Infectious jaundice in Sudan, 359

CRUTO, Dr. A., and TROCELLO, Prof. E.—Further researches on the preservation of insulin, 1

DEEKS, Dr. WILLIAM E.—Some aspects of malaria control, 185

FLETCHER, WILLIAM, M.D., M.R.C.P., and LESSLAR, J. E., Dipl., Madras.—Tropical typhus and Brill's disease, 374

GRANT, A. R., M.D.Aberd., and SILVERSTON, J. D., M.B., B.S.Durh.—Whittingham (W) strain of artificially-induced malaria, 117

HALL, G. ROME, M.D.—Malaria in West Africa, 70

HARDE, E., M.D.—Influence of acid reaction on virus of chicken sarcoma (Rous) and its importance in experiments of Dr. Gye, 159

HOFFMANN, Prof. W. H.—Anatomical observations on yellow fever problem in Africa, 69

—— Yellow fever control in West Africa, 349

JACOBAEUS, Prof. H. C.—Cauterization of adhesions in artificial pneumothorax treatment of pulmonary tuberculosis. Technique and indications, together with a survey of results obtained, 327

KING, W. V., and BRADLEY, G. H.—Airplane dusting in control of malaria mosquitoes, 311

LAGRANGE, E., M.D.Liège, D.T.M.Paris.—Concerning the discovery of plague bacillus, 299

LAMPE, Dr. P. H. J.—Bilharzia treatment. Experience gained from more than 3,000 tartar emetic injections. Precautionary measures. Results obtained, 4

LESSLAR, J. E., Dipl., Madras, and FLETCHER, WILLIAM, M.D., M.R.C.P.—Tropical typhus and Brill's disease, 374

LUCAS, CATHERINE L. T., B.Sc.Lond., and THOMSON, J. G., M.A., M.B., Ch.B.—Preliminary note on study of *Endamœba blattæ* (Butschli, 1878) Leidy, 1879, found parasitic in intestine of *Blatta orientalis* in England, with some remarks on its generic status, 41

MCCONNELL, R. E., B.A., M.D., and MCGILL, C. M., D.T.M. Liv.—Note on corneal ulcer in malaria, 3

MANALANG, C.—Ankylostomiasis: comparative carbon tetrachloride, chenopodium and thymol in treatment of hookworm infection, 101

MARSHALL, C. H., M.B., B.S.Lond., F.R.C.S.Edin., and VASSALO, S. M., M.D., D.T.M. & H.—Final report on treatment of trypanosomiasis in Uganda, 85

NEFF, E. A.—Leprosy in fourteen months' old child, 146

NEWHAM, H. B., C.M.G., M.D., M.R.C.P.—Notes on analysis of sprue stools, 169

NICOLE, J. ERNEST, L.M.S.S.A.Lond., and STEEL, JOHN P., M.B., Ch.B.Edin.—Further report on acquired immunity to malarial inoculation, 48

O'BRIEN, HENRY R., M.D.—Hookworm control with chenopodium-carbon tetrachloride, 227

PERUZZI, MARIO, M.D.—Morphological and cultural investigation of *Vibriothrix zeylanica* Castellani, 44
PITTALUGA, Professor G.—Epidemiological study of leishmaniasis visceralis in Spain, 387

RAMSBOTTOM, J.—Notes on mycology, 291
REPPER, E. N. D., M.B., Ch.B.— Epidemic of cholera amongst ballast train coolies in Bengal, 196
RIBOLLA, ROMOLO, M.D.—Contribution to study of pathogenesis and treatment of sea-sickness, 59
RIDLEY, H. N.—Cause of hairlessness of man, 313
ROBERTSON, ANDREW, M.B., Ch.B., and THOMSON, J. G., M.A., M.B., Ch.B. Variations in the virulence and in the morphology of certain laboratory strains of *Trypanosoma gambiense* and *Trypanosoma rhodesiense* isolated from human cases, 403
ROSS, Sir RONALD, K.C.B., K.C.M.G., F.R.S.—Malaria-control in Ceylon plantations, 150
—— Simian journalism, 335

SAMBON, LOUIS WESTENRA, M.D.—Observations and researches on epidemiology of cancer made in Holland and Italy (May-September, 1925), 233
—— Refutation of statements made by Prof. R. T. Leiper, M.D., D.Sc., F.R.S., concerning African schistosomes, "American" gongylonemas, zoo vermin and Italian cancer houses, 314
SHEATHER, A. L., D.Sc., M.R.C.V.S., ANDREWS, W. H., D.Sc., M.R.C.V.S., and BAYLIS, H. A., M.A., D.Sc.—Further experiments with *Gongylonema* of cattle, 194, 346
SILVERSTON, J. D., M.B., B.S.Durh., and GRANT, A. R., M.D.Aberd.—Whittingham (W) strain of artificially induced malaria, 117
SPAAR, ERIC C., M.D., B.S., B.A.Lond., M.R.C.P.—Brief note on biochemical reactions of certain fungi, viz., *Monilia krusei, M. macedoniensis,* and *M. tropicalis,* 47
STEEL, JOHN P., M.B., Ch.B.Edin., and NICOLE, J. ERNEST, L.M.S.S.A.Lond.—Further report on acquired immunity to malarial inoculation, 48

TAYLOR, F. E., M.D., F.R.C.S., D.P.H., and CASTELLANI, ALDO, C.M.G., M.D., F.R.C.P.—Further observations on mycological method to identify various sugars and other carbon compounds, 201
THOMSON, JOHN GORDON, M.A., M.B., Ch.B., and ANNECKE, S., M.A., M.B., D.P.H.—Observations on pathology of central nervous system in malignant tertian malaria, with remarks on certain clinical phenomena, 343
—— and LUCAS, CATHERINE, L. T., B.Sc.Lond.—Preliminary note on study of *Endamœba blattæ* (Butschli, 1878) Leidy, 1879, found parasitic in intestine of *Blatta orientalis* in England, with some remarks on its generic status, 41
—— and ROBERTSON, ANDREW, M.B., Ch.B.—Variations in the virulence and in the morphology of certain laboratory strains of *Trypanosoma gambiense* and *Trypanosoma rhodesiense* isolated from human cases, 403
TOMB, J. W., O.B.E., M.D., D.P.H.—Prevention and treatment of cholera by essential oils, 210
TROCELLO, Prof. E., and CRUTO, Dr. A.—Further researches on the preservation of insulin, 1

VACHHRAJANI, B. C., L.M.& S., B.M.S.—Notes on use of eserine in glaucoma, 303
VASSALLO, S. M., M.D., D.T.M. & H., and MARSHALL, C. H., M.B., B.S.Lond., F.R.C.S.Edin.—Final report on treatment of trypanosomiasis in Uganda, 85

WHITEHEAD, N. T., M.C., M.B., Major R.A.M.C., and CROUCH, H. A., M.C., M.R.C.S., L.R.C.P.—Infectious jaundice in Sudan, 359

ZIEMANN, H., M.D.—Remarks on Clayton-Lane's criticism of my monograph on malaria and blackwater fever in *Tropical Diseases Bulletin,* 1925, vol. 22, No. 4, p. 338, 89

GENERAL INDEX.

A

ABSTRACTS :—

Ankylostomiasis, carbon tetrachloride treatment, with note on hookworms of Penang, 139
Latrines and hookworm incidence on an estate, some notes, as diagnosed by Clayton-Lane centrifuge, 78
Malaria control measure, destroying engorged anopheles, 355
Small-pox and climate in India. Forecasting of epidemics, 307
Vibrios in human excrement, 97
Acid reaction, influence on virus of chicken sarcoma (Rous) and its importance in experiments of Dr. Gye, 159
Acquired immunity to malarial inoculation, further report, 48
Adhesions, cauterization in artificial pneumothorax treatment of pulmonary tuberculosis, 327
Africa, anatomical observations on yellow fever problem, 69
African schistosomes, "American" gongylonemas, zoo vermin and Italian cancer houses, refutation of statements made by Prof. R. T. Leiper, M.D., D.Sc., F.R.S., concerning, 314
Analysis of sprue stools, notes, 169

ANNOTATIONS :—

Albuminuria, production by renal vaso-constriction in animal and man, 111

ANNOTATIONS—*continued.*

Alopecia, congenital, 183
——, generalized, 307
——, persistent, production in rabbits by X-rays of various degrees of hardness, 91
Anæmia, blood-transfusion in pernicious, 304
——, sickle-cell, case in Sudan, 215
——, value of iron, 49
Ancylostome, ascaris, and trichuris infections, effect on health of West African native, 94
Ankylostomiasis among troops in Dehra Dun, 113
Antimeningococcus serums, comparison of potency polyvalency and therapeutic action, 381
Anti-rabic procedure in Palestine with special reference to decentralization of treatment, 94
Ascaridia perspicillum, studies of resistance of chicken to nematode, 110
Atherosclerosis and ingested cholesterol in rabbit, relation between, 325
Bacillus aertrycke (Mutton), relation between age and virulence of cultures, 401
——*dysenteriæ* Shiga as a vaccine, observations on employment of anaerobically-grown, 77
—— —— ——, report of typical and atypical, with special reference to agglutination reactions, 97
—— of paratyphoid group, 67
—— typhosus, variation in amount of soluble protein contained in old broth cultures, 114

ANNOTATIONS—*continued.*

Bacteria flagella, abnormal, in cultures, 212
Bacterial pollution and natural purification in Ohio and Illinois rivers, quantitative studies, 182
Bacteriological examination of water, correlation of sulphite reduction test with other tests, 15
Bacteriophage, studies on regeneration, 399
Beriberi in dog, gastric secretion in experimental, 166
Bilharziasis of female genital tract, 15
Bismuth compounds as revealed by Roentgen ray, intramuscular absorption of some insoluble, 161
Brazilian bubo, interesting case, 369
Bronchial affections, use of iodized oil in diagnosis and treatment, 214
Calcium absorption from intestinal tract in human subjects, 231
Carbohydrate, intestinal intolerance associated with overgrowth of gas bacillus, 165
Carcinoma, primary, of liver, 229
Chaulmoogra oil, fractionation, 14
Chilomastix gallinarum, morphology, division and cultivation, 339
Colitis, ætiology of chronic ulcerative, 112
Common cold, studies, 149
Constipations, non-surgical, functional and mechanical, 353
Creeping eruption, 113
Cultivation of *Herpetomonas muscarum* from *Lucilia sericata*, 412
Dengue, 162
Deodorization of coconut oil, 413
Depopulation of New Hebrides and other parts of Melanesia, 305
Diabetes mellitus, gastric secretion, 383
——, pathology, with special reference to pancreatic regeneration, 78
Differential fertility in United States, new data, 380
Dysentery carriers in Philippine Islands, contribution to question, 96
—— in India, important features in correct diagnosis, 163
Eczema, notes on ætiology, 167
Elephantiasis, syphilitic pesudo-, 37
Embadomonas cuniculi, morphology and cultivation, 382
Emetine periodide in treatment of *Schistosoma hæmatobium* infections amongst West African children, 412
Encephalitis in rabbits, geographical distribution of spontaneous, 307
——, medico-legal and sociological aspects of epidemic, 40
——, studies on ætiology of epidemic, 381
Epidemic disease in West Africa, 97
Erysipelas, 324
Erythema multiforme, 182
Erythrocytosis in artificially-inoculated malaria, 94
Fever resembling mild form of typhus fever, 183
Genus Strongyloides Grassi, biological studies on life cycle, 339
Giardia intestinalis, case treated with stovarsol, 400
Goitre, endemic, in New Zealand and its relation to soil-iodine, 110
——, exophthalmic, 214
—— ——, effect of compound solution of iodin and rest in surgery, 149
——, iodized salt in prevention, 214
——, salmon in diet for prophylaxis of, 199
Granuloma iguinale, ætiology with clinical report of three cases, 96
Guarnieri bodies, is formation an exclusively mammalian response to infection with vaccine virus? 380
Hæmic plasma cells, significance in various infective conditions, 40
Hæmochromatosis and chronic poisoning with copper, 183

ANNOTATIONS—*continued.*

Hæmolytic streptococci obtained from cases of scarlet fever, serological classification, 367
Hay's sulphur tests, clinical value for detecting bile acids in urine, 385
Herpetomonas elmassiani (Migone), relation to its plant and insect hosts, 66
Hexylresorcinol as internal urinary disinfectant, present status, 112
Hookworm and ascaris infections, treatment with carbon tetrachloride and oil of chenopodium, 95
—— diagnosis, place of smear, 402
—— disease in Mexico, observations, 401
—— ——, relation of type of soils of Alabama to distribution of, 164
—— ——, treatment of pregnant women with carbon tetrachloride, 166
—— infection, factors that influence rate of increase, 95
—— infections, light, evaluation of methods of Stoll and Lane and accuracy in diagnosis of Willis flotation method, 400
—— infestation and re-infestation in Ceylon, 164
—— ——, comparison of Stoll and Lane egg-count methods for estimation, 378
—— —— in Alabama, intensity, 95
—— larvæ, observations on development, 384
—— re-infection, 95
—— reinfestation for three years after treatment in sanitated area in Porto Rico and its bearing on permanent hookworm control in group studied, 401
——, studies and observations on soil infestation in Southern Alabama from October, 1923, to September, 1924, 164
Hookworms, estimation of number harboured, by use of dilution egg-count method, 385
——, rate of loss in absence of re-infections, 143
Hydatid disease, mechanism of daughter cyst formation, 324
Hypertension, action of hepatic extract, 402
Immunity, rôle of reticulo-endothelial system, 325
Infectious disease of skin, use of mercurochrome-220 soluble in treatment of, 165
Kala-azar, epidemiological consideration of transmission, 381
—— in India, epidemiological consideration of transmission, 398
——, study of incidence in certain parts of North Behar, 325, 401
Laboratory evaluation and classification, proposed method, 402
Lagocheilascaris minor, case of infection, 380
Larval trematode infestation of fresh-water mollusc of San Juan Island, Puget Sound, 12
Leishmaniasis, cutaneous, further observations on transmission to man from *Phlebotomus papatasii*, 383
—— —— reaction, 149
Leper's sera, serological analysis, 179
Leprosy, formol-gel reaction, 14
——, new method of diagnosis and vaccine treatment, 216
——, studies on serology, I, 354; II, 353
——, treatment by vaccine of autolysed tubercle bacilli, 216
—— —— with compounds of antimony, 14
—— —— —— derivatives of chaulmoogra oil, 10
——, Wassermann reaction, Kolmer's new complement-fixation test, and Kahn precipitation test, 14
Leukoplakia buccalis, 67
Lobar pneumonia, nasal passages, 181
Lung tumours, primary, in mice following cutaneous application of coal tar, 78
Lymphatic leucæmia, neoplastic nature and its relation to lymphosarcoma, 381
Madura foot (mycetoma), 112

ANNOTATIONS—*continued.*

Malaria in Palestine, epidemiology, 351
—— —— Trinidad, B.W.I., some observations on malignant tertian, 77
——, mountain, field study in Brazil, 97
Malarial fevers in U.S. Army and at selected stations, 306
—— fever, treatment, 49
Malignant disease, remarks on new flocculation reaction for serodiagnosis, 66
Medical aspects of life insurance in India with special reference to Calcutta, 412
Medical research in China, 163
Melioidosis: disease of rodents communicable to man, 13
Meningitis due to *Bacillus enteritidis* Gaertner, 385
Mercuric chloride poisoning, acute, 144
Micro-organisms, group, transmitted hereditarily in ticks and apparently unassociated with disease, 50
Miliary lichen planus, 96
Military service in Tropics, and its effect on health and efficiency, 306
Milkweed flagellate, *Herpetomonas elmassiani* (Migone), geographical distribution, 64
—— —— in Maryland, non-pathogenicity, 93
Modifying course of infections with bird malaria by changing sugar content of blood, 380
Moniliasis, case of pulmonary, 12
Myocarditis, syphilitic, in rabbit, 231
Mycosis fungoides. Its relation to leukemia and lymphosarcoma, 93
Neoplasms, causation of malignant, 338
Nephritis, relation of albuminuria to protein requirement, 132
Neurosyphilis, treatment by malaria, 182
—— —— with tryparsamide, 162
Observations on pathology of central nervous system in malignant tertian malaria, with remarks on certain clinical phenomena, 343
Occupational disease among zinc workers, 382
Œdema, angioneurotic, 214
Ohara's disease and tularæmia, identity, 212
Onchocerca volvulus, development in *Simulium damnosum*, 111
—— —— Leuckart, contribution to study, with some observations on its prevalence in Nigeria, 167, 216
—— —— ——, further development in *Simulium damnosum*, Theob., 401
Oral infection with ankylostoma, studies, 382
Oriental sore, emetine hydrochloride in treatment of, 76
Oroya fever, ætiology, 354
Osteomalacia in China, 40
Paralysis, occurrence after treatment with antirabic vaccine, 132
Paramecia of blood-serums, effect, especially from patients with carcinoma, 113
Paratyphoid-enteritidis infection of white mice, microbic virulence and host susceptibility, 111
Pemphigus, unusual type, 351
Peritonitis, pneumococcic and streptococcic, 132
Plague and regulation of numbers in wild animals, 66
Plankton, relationship to Anopheline larvæ, 381
Plant-food constituents of Philippine guano, nature and availability, 354
Pneumococcus growth inhibition, studies, 325
Pneumonia, epidemiology, 399
Poliomyelitis, epidemic bulbar. Report of six cases with one necropsy, 108
Principles in the testing of a cure, 412
Proteins, urinary, 215
Protozoa, stool examination, 94
Queensland, tropical, observations on white working population, 181
Quinine, experiments on administration in watery solution in olive oil, 229

ANNOTATIONS—*continued.*

Quinine, hæmoglobinuria in man, certain observations on mechanism, 144
——, rectal injections, 163
Rabies fixed-virus, rate of multiplication in rabbits, 144
Rat-bite fever, experimental studies with spiral organism found in wild rat and identical with organism causing, 50
—— fleas, destruction by heat on board ship, 148
—— poisoning, outbreak, probably due to rat virus, 149
Recklinghausen's disease without tumour formation, 112
Ringworm of scalp in adult, 179
—— species in toes, morphologic variations, 139
Rocky Mountain spotted fever, 13
—— —— —— —— tick, *Dermacentor andersoni*, cultivation of rickettsia-like micro-organisms, 231
Rheumatic fever, acute, study of hemolytic streptococci with analysis of antigenic relationship existing among certain strains, 94
Scarlet fever, 181
—— ——, studies on epidemiology, 383
Sickle-cell anæmia in Sudan, case of, 166
Sleeping sickness, second case in Sudan caused by *Trypanosoma rhodesiense*, 385
Sodium citrate injections, changes in respiration, circulation and coagulation time of blood produced by, 161
Spirochætosis bronchialis, case of, 13
Spontaneous disease, effects on organ weights of rabbits, 113
Sporotrichosis in man, 112
Street risk of carbon-monoxide poisoning, 410
Studies on the serology of leprosy. III: The Kahn precipitation reaction in leprosy, 413
Syphilis and other skin diseases, blood cholesterol finding, 166
——, bismuth in treatment of, 96
——, curative effect of bismuth compounds in experimental rabbit, 93
——, intravenous administration of sulpharsphenamin, 147
——, resistant, protein as adjunct in treatment, 130
——, tryparsamide, 15
Syphilitic alopecia: its relation to neuro-syphilis, 158
Trachoma in Philippine Islands, preliminary report on control, 108
Trichomonas buccalis, studies, 166
——, cultivation, thermal death-point anaerobic conditions, attempts at sterilization, 383
Trophozoites of intestinal protozoa and their bearing on function of cysts, animal infections, 380
Trypanosome infections, susceptibility and resistance, 324
Trypanosomes, mode of action of Bayer "205," 215
Tuberculosis, effect of parathyroid on certain signs and symptoms in, 353
—— in the Tropics, 39
——, pulmonary, incidence in Colombo as indicated by examination of sputa found in public places, 95
Typhoid fever in Cochin China, 167
Ulcer, gastric and duodenal, 181
Ulcers, healing of gastric, 114
Uncinariasis, employment of carbon tetrachloride followed immediately by magnesium sulphate in treatment of, 93
Urinary tract, hexylresorcinol in infection of, 166
Urobilin physiology and pathology, studies, 306
Varicose ulcers, new application, 165
Viable bacilli, proportion in agar cultures of *Bacillus aertrycke* (Mutton), with special reference to change in size of organisms during growth, and to capacity to which they give rise, 386
Wild rats, disease with gross pathology resembling plague, 76

Artificially induced malaria, Whittingham (W) strain, 117
Artificial pneumothorax treatment of pulmonary tuberculosis, cauterization of adhesions, 327
Aspects, some, of malaria control, 185
Association of different species of organisms in production of certain biochemical phenomena and in causation of certain diseases and certain symptoms of disease, observations on importance of symbiosis or close, 217

B

Bacteria, plants and vertebrates, virus diseases, 17
Bengal, epidemic of cholera amongst ballast train coolies, 196
Bilharzia parasite in South Africa, environmental influences which favour development and spread. Food supply of "Physopsis," 89
Biochemical reactions, brief note, of certain fungi, viz., *Monilia krusei*, *M. macedoniensis*, and *M. tropicalis*, 47
—— —— of *Vibriothrix zeylanica* Castellani, brief note on morphology, cultural characters and, 371
Blatta orientalis in England, preliminary note on study of *Endamœba blattæ* (Butschli, 1878) Leidy, 1879, found parasitic in intestine of, with some remarks on its generic status, 41
Brill's disease, tropical typhus and, 374
Bronchomycosis, notes on case, 145

C

Cancer field commission in Trentino, 1925, entomological notes, 294
——, observations and researches on epidemiology, made in Holland and Italy (May-September, 1925), 233
Cancerous and other tumours in animals collected by Dr. Sambon during his recent researches, examination, 298
Carbon compounds, further observations on mycological method to identify various sugars and, 201
—— tetrachloride, chenopodium and thymol in treatment of hookworm infection, ankylostomiasis: comparative efficiency of, 101
Cattle, further experiments with *Gongylonema*, 194, 346
Central nervous system in malignant tertian malaria, observations on pathology, with remarks on certain clinical phenomena, 343
Chenopodium-carbon tetrachloride, hookworm control with, 227
Cholera, epidemic amongst ballast train coolies in Bengal, 196
——, prevention and treatment by essential oils, 210
Clayton-Lane's criticism of my monograph on malaria and blackwater fever in *Tropical Diseases Bulletin*, 1925, vol. 22, No. 4, p. 338, remarks, 89
Climatic bubo, or subacute inguinal poradenitis, 103
Comparative efficiency of carbon tetrachloride, chenopodium and thymol in treatment of hookworm infection, ankylostomiasis, 101
Control of malaria mosquitoes, airplane dusting, 311
Coolies in Bengal, epidemic of cholera amongst ballast train, 196
Corneal ulcer in malaria, note, 3

CORRESPONDENCE :—
Lane, Clayton-, 200

Cultural characters and biochemical reactions of *Vibriothrix zeylanica* Castellani, brief note on morphology, 371
—— investigation, and morphological, of *Vibriothrix zeylanica* Castellani, 44

CURRENT LITERATURE :—
Alastrim, investigations in Belgian Congo, 142
Amœbic colitis. Its treatment by transduodenal medication, 155
Anopheles in higher regions of Corsica, 99
Anopheles vestitipennis, occurrence in Porto Rico, 156
Anopheline control, Bombay millponds, 200

CURRENT LITERATURE—*continued.*
Anti-piroplasmic campaign in Government of Petrograd in 1925, 184
Appendicitis, extraperitoneal amœbic abscess simulating, 114
Babesiasis in North-West Russia, ichtargan in treatment of bovine, 184
Bilharziasis, case of intestinal, due to *Schistosoma hæmatobium*, 143
——, intestinal, in form of abdominal tuberculosis, 99
Bilivaccin-cholera *versus* commercial cholera vaccine, 358
Blackwater fever, manifest action of cold, 184
—— —— syndrome during course of attack of malaria, 115
Bouffissure in Annam, pathogenicity, 309
Brucella melitensis, geographical distribution of serologic groups, 84
Coccidiosis of domestic animals in Russia, 308
—— —— pigs in Russia, 308
——, rôle of gastric juice in natural immunity of rabbits, 309
Cholera, account of outbreak at Goalundo Ghat, 100
—— in Punjab, 99
Clonorchiasis, cure by tartar emetic, 155
Developments in anthelmintic medication, 413
Diabetes, some observations on blood-sugar after treatment with insulin, 340
Diagnosis, differential, in Tropics, 199
Digitalis, Indian, 200
—— preparations in Tropics, variations in potency, 340
Dysentery, bacillary, review of recent epidemic, with special reference to a new therapy, 51
—— in Indian jails, trial of oral vaccination against bacillary, 358
Enteritis due to trichomonas cured by stovarsol, three cases, 99
Filariasis in European in New Caledonia, 99
Framboesia tropica, or yaws, some observations on tertiary lesions, 155
Herpetic virus of Moroccan origin, note, 98
Herpetomonas muscæ domesticæ, isolation and cultivation, 326
Histoplasmosis of Darling with report of a case originating in Minnesota, 414
Hookworm infections in Asansol Mining Settlement, some factors affecting propagation, with special reference to part played by cockroaches in mines, 339
Hospital accommodation, provision, with particular reference to infectious diseases, 51
Hymenolepis nana, note on existence in Tunis, 16
Influenza, note on value of iodine intravenously in treatment of, 67
Kala-azar, case in Simla Hills, 100
——, experimental immunity of dog; evolution of malady in dogs; natural immunity and immunity by first natural attack, 16
—— —— researches on mode of transmission, 16
—— of Honan, Central China, note, 115
——, three cases in adult in Tunisia, 16
Keratosis, prescorbutic pilous, 184
Leishmania infantum, case observed in Sienna, Italy, 184
Leishmaniasis, American, of frontal sinus, 98
——, two new cases of cutaneous, observed in natives of Morocco in region of Fez, 98
Leprosy, external medication, 340
Malaria, an essentially curable disease, treatment, 183
——, benign tertian, notes on treatment with cinchona febrifuge, 358
——, influence of obstacles unconsciously erected against anophelines (housing and screening), upon incidence of, 156
——, mosquito species control, 326
—— of Assam tea gardens, mosquito factor, 67

CURRENT LITERATURE—*continued.*

Malaria, on inefficiency of "Mercurochrome 220" in treatment of, 200
——, quartan, occurrence in low coastal regions of State of Rio de Janeiro, 326
——, treatment with peracrina, 67, 303
Mosquitoes, use of larvicidal powders against, 309
Nodosity, asymmetrical juxta-articular, case in European in Belgian Congo, 143
Observations on the emergence of anopheline mosquitoes, 414
—— on *Dientamœba fragilis*, 414
Paramelitensis, note, 16
Parasites, intestinal, in natives of military colonial corps in France, 114
Pellagra in Nyasaland, some observations, 51
Piroplasmosis, bovine, apiroplasmine in treatment, 184
Plague centre in South-East Russia, epidemiological study, 98
——, investigations in Cambodia in 1924, carried out at laboratory of Pnom-Penh, 98
—— prevention, natural enemies of rats: their possibilities in, 51
Prickly heat, 357
Quinine, action on schizonts of *Plasmodium malariæ*, 115
Rat-bite fever, experimental, 155
Sanguicolous spirochæte in domestic dog, 114
Sleeping sickness in Portuguese Guinea, 309
—— ——, treatment by tryparsamide, 309
Some atypical cases of yellow fever in Salvador, 414
Spirochætal pulmonary affections of Madagascar, 308
Spirochætosis in fowls in Greece, 114
Sprue, pernicious anæmia, and combined degeneration, common picture, 326
Syphilis and yaws, experimental immunity, 84
——, treatment by benzo-bismuth, 340
Tokelau (*Tinea imbricata*) in Chinese Province of Honan, 99
Trachoma in Morocco and its treatment, study, 184
Trichomonas prevalent in Calcutta, species, 100
Tropical hydrocele, significance of cholesterol, 156
Trypanosomiasis, action of tryparsamide on chronic, 184
——, animal, treatment with "205 Bayer," 143
—— census of populations of Miriu River, Central and South Kavirondo Districts, Nyanza Province, note, 51
——, stovarsol or "acido acetylxylaminophenylarsinic" in treatment of human, 143
Tuberculosis in Bengal, 348
Typhoid-like fevers, diagnosis, with special reference to typhoid and kala-azar, 357
Ulcero-membranous and scorbutic stomatitis, notes, 183
Urticaria, occurrence in treatment of malaria by quinine, 100
Venereal diseases, measures in Uganda, 50
Wounds, lacerated, treatment within two hours, 199
Yaws, congenital, 200
——, contribution of posology of stovarsol: hebdomadal doses of stovarsol, 115
—— —— to clinical study and treatment, 143
—— in Costa Rica, suspected, 84
Yellow fever campaign in Colombia, May, 1923, to December, 1924, general report, 83
—— ——, epidemic in Liberia, 115
—— —— mosquito, *Ædes ægypti* (Linn.), in Colombia, prevalence, 84
—— —— —— —— —— —— prevalence and distribution in Venezuela, 326

D

Discovery of plague bacillus, concerning the, 299
Diseases, virus, of bacteria, plants and vertebrates, 17
Dusting, airplane, in control of malaria mosquitoes, 311

E

Endamœba blattæ (Butschli, 1878), Leidy, 1879, preliminary note on study, found parasitic in intestine of *Blatta orientalis* in England, with some remarks on its generic status, 41
Epidemiology of cancer, observation and researches made in Holland and Italy (May-September, 1925), 233
Eserine in glaucoma, notes on use, 303
Experiences, note on further, of use of Panama hat in Tropical Africa, 303
Experiments, further, with *Gongylonema* of cattle, 194, 346
—— of Dr. Gye, influence of acid reaction on virus of chicken sarcoma (Rous) and its importance in, 159

F

Fourteen months old child, leprosy in a, 146
Fungi, viz., *Monilia krusei*, *M. macedoniensis*, and *M. tropicalis*, brief note on biochemical reactions of certain, 47

G

Glaucoma, notes on use of eserine in, 303
Gongylonema of cattle, further experiments, 194, 346

H

Hairlessness of man, cause, 313
Head, protection against the sun's rays in Tropical Africa, 2
Hepaticola gastrica Baylis, 1925, cancer of stomach of wild rat and infection with nematode worm, 288
—— (nematoda), new species from rat's stomach, 226
Hookworm infection, ankylostomiasis: comparative efficiency of carbon tetrachloride, chenopodium and thymol in treatment of, 101

I

ILLUSTRATIONS:—

Adige, view of upper valley, 236
Aphodius fimetarius, 258
—— *hæmorrhoidalis*, 258
Appearance of lung a few days after cauterization, 335
Bilharziasis affecting lungs, photomicrograph. *B. miliaris pulmonum*, 8
—— —— peritoneum, photomicrograph. *B. miliaris peritonei*, 8
Blatta orientalis Fol., 260
—— —— nymph, 261
Blattela germanica, 260
Blood-vessel showing partial thrombosis and filled with tumour cells (2 figures), 289
Broncho-spirochætosis, 361, 364
—— —— of purulent type, lung, 364
B. typhosus, action on maltose alone, gas absent, 219
Caccobius schreberi, 258
Cancer mortality in Holland, sketch map, 237
—— —— in Italy, sketch map, 237
Cantlie, Sir James, 157
—— —— —— and Surgeon-General Rho, Italian Navy, examining an enormous growth on elm tree at Buntingford, 271
Carcinoma, case of breast, from Pederzano, near Villa Lagarina, 235
—— in cardiac portion of rat's stomach with *Hepaticola gastrica* embedded in growth, 256
Cavedago, 236
Cavity in upper part of lung, 333. Same case after first operation, 333; same case after second operation, 334
Ceratophyllus fasciatus with *Tyroglyphus sp.* in hypopus stage, 287
Changes in state of nutrition, 57
Coredo, Dr. Ossana's house, 245
Cortina, 238
Crown-gall, longitudinal section of pear-tree stem showing tumour-strand, 273
—— on apple tree, 271

ILLUSTRATIONS—*continued.*

Crown-gall, grape-vine, 272
—— —— pear tree, 272
Crytococcus graciloides and *B. vermiculoides* in symbiosis, 222
Dirofilaria immitis attacked by microsporidian within Malpighian tubes of *Anopheles maculipennis*, 280
Double-bladed guarded scarifier, 125
Dust cloud beginning to spread out among trees following trip of plane across Bienkiem Woods, 311
—— ——, view of another, left in treating marginal zone of Field Lake, 312
Dusting marginal zone of Field Lake, 312
—— plane flown across open field, 311
—— —— making flight over centre of St. Via Lake, 312
Epithelial tumours arising from multilocular cyst, kidney of rat, 249
—— —— in rat's kidney, 249
Fraviano, 239
Gongylonema, eggs of mouse, 252
—— from mouse, anterior end, 252
—— larva (third stage), encapsuled, from *Onthophagus taurus* (2 figures), 259
—— of cattle, two third-stage larvæ, from an experimentally-infected *Blattella*, 259
Hæmogregarina seligmanni Sambon, 1977, from Bushmaster, 282
Helminths often associated with cancer in rat and apparently determining its visceral location, diagram, 286
Hepaticola gastrica, 226, 263
—— ——, eggs from rat's stomach, 289
—— ——, eggs, 226
—— —— —— in epithelium, 289, 290
—— —— in stomach tumour, cross section, 290
Holland, village of Rauwerd, 238
Hydatigera tænæformis Batsch, 1786, 247
—— —— —— ——, larval form, 246
—— —— —— ——, embedded in sarcoma of rat's liver, 250
Idaard, 243
Isidora africana (Krauss), shells, 178
Lake dusting, one of the pans containing larvæ and floating on surface of water, 313
Leishmaniasis visceralis (infantile kala-azar), distribution of cases in Spain (1925), 389
Maltose, identification, 202
Mezzana, 240
Mortality per 10,000 living from every age in 1909, 58
Muspicea borrelli Sambon, 1925, 265, 266
Observations on importance of symbiosis or close association of different species of organisms (1 figure), 217
Œsophagus of heifer from Villa Lagarina with numerous *Gongylonema* beneath epithelium, 257
Oniticellus fulvus, 258
Onthophagus taurus (2 figures), 257
Opisthorchis felineus (Rivolta), 1885, 241
Palisade arrangement of cells lining central lumen of tumour cords, 289
Pane's "*Filaria labialis*," a *Gongylonema*, probably *G. pulchrum*, 251
Paramecium parasitized by *Sphærophyra*, 279
Plant-lice, dry, distended skins still clinging to black-currant stem and out of which have emerged *Ichneumonids*, 280
Pleomorphism of *Vibriothrix zeylanica*, 371, 372
Position of patient—on his healthy side—at operation, 328
Pristonychus terricola, ♀, 296
Proliferation near tumour, buds of epithelial, 290
Rat flea covered with mites, 270
Rat's mammary tumour, section, 288
Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S.W., 230
Ross's "black spores," 279

ILLUSTRATIONS—*continued.*

Saccharose peptone water inoculated with *Monilia tropicalis*, 221
—— —— —— —— —— —— —— + *Bacillus typhosus*, 221
S. bronchialis, various types (2 figures), 362
Schistosoma mansoni, clinical case of native, 6
—— —— in Dutch Guiana, photograph of shells of *Planorbis olivacæus*, immediate host, 6
Signorina Ottaviani, Dr. Carega and the writer at Rio Sambuci, 255
Slide presented by Kitasato to Yersin, 301
S. Lorenzo in Pusteria, group of "cancer houses," 239
S. Michele-on-Adige, 242
Sphodrus leucophthalmus, 296
Stomach tumour, general view, 290
—— ——, section, 288
String-shaped adhesion obliquely upwards and outwards immediately below clavicle, 334
Strobilocercus fasciolaris, large spindle-celled tumours arising from cyst in liver of rat, 248
Swamp lakes, one of larger, 312
Sydenham pool, Durban, favourite haunt of *Isidora africana*, 177
—— —— ——, showing *Cyperus immensus* in profusion, 177
—— —— (infested) showing blue lotus in flower, 178
Trichomycosis nigra. 224
Trichosomoides crassicauda from urinary bladder of Villa Lagarina rat, male in female's uterus, 264
Tumour, growth beneath slightly hypertrophied epithelium of stomach, 289
Typical quotidian curve, 118
—— tertian curve, 118
Villa Lagarina (2 figures), 234
—— —— rat with fibro-adenoma of mammary gland and malignant papillomatous growth in stomach, 256
Water chinquapui, growth in Blue Tuoret Lake, 313
Wick-syphonage, apparatus, 128
Yellow fever, kidney of case, showing lime casts, 69
—— —— ——, one of cases from West Africa, 69
Yersin's diary, from, 302
—— hut close to Alice Memorial Hospital, 301

Immunity to malarial inoculation, further report on acquired, 48
Influences, environmental, which favour development and spread of bilharzia parasite in South Africa. Food supply of "Physopsis," 89
Inoculation, malarial, further report on acquired immunity, 48
Insulin, further researches on preservation, 1
Investigation, morphological and cultural, of *Vibriothrix zeylanica* Castellani, 44

J

Jaundice in Sudan, infectious, 359
Journalism, simian, 335

L

LEADING ARTICLES :—

Bacteriophage, nature, 323
Blastomycosis, systemic, 76
Bronchomoniliasis, 109
Bronchomycosis, rarer, 179
Colombia and its diseases, 337
Cancer, treatment by lead, 304
Framboesia, relation to syphilis, 38
Giardiasis, 49
Gangrene in malaria, 213
——, spirochætal pulmonary, 65
Malaria in women, 379
Mosquitoes of Egypt, 11
Pellagra, dietetic theory, 92
Public health on Gold Coast, 147

LEADING ARTICLES—*continued.*

Ross Institute, opening, 229
Thrush, vaginal, 131
Treatment of tropical sore, 410
Tropical fevers, diagnosis, 198
Tularæmia, 351
Yaws, bone lesions, 368
—— in the Philippines, 398

Leiper, Prof. R. T., M.D., D.Sc., F.R.S., refutation of statements made concerning African schistosomes, "American" gongylonemas, zoo vermin and Italian cancer houses, 314
Leishmaniasis visceralis in Spain, epidemiological study, 387

M

Malaria and blackwater fever, remarks on Clayton-Lane's criticism of my monograph in *Tropical Diseases Bulletin*, 1925, vol. 22, No. 4, p. 338, 89
—— control, some aspects, 185
—— mosquitoes, airplane dusting in control, 311
——, note on corneal ulcer in, 3
——, observations on pathology of central nervous system in malignant tertian, with remarks on certain clinical phenomena, 343
——, Whittingham (W.), strain of artificially induced, 117
Malarial inoculation, further report on acquired immunity, 48
Medical news: 16, 84, 116, 200, 232, 216, 309
Monilia krusei, *M. macedoniensis*, and *M. tropicalis*, brief note on biochemical reactions of certain fungi, 47
Morphology, cultural characters and biochemical reactions of *Vibriothrix zeylanica* Castellani, brief note, 371
Mycological method, further observations to identify various sugars and other carbon compounds, 201
Mycology, notes on, 291

N

Nematode worm, *Hepaticola gastrica* Baylis, 1925, cancer of stomach of wild rat and infection with, 288

NEW PREPARATIONS, INVENTIONS, &C.:

Agla micrometer syringe apparatus, 310
Bismuth treatment in syphilis, 52
Santonin, 310
Sodium salts of tetrabrom-phenolphthalein and tetra-iodo-phenolphthalein, 310
Sulfoxyl salvarsan, 52

O

OBITUARY:—

Cantlie, Sir James, K.B.E., M.A., M.B., C.M., LL.D. Aberd., F.R.C.S.Eng., D.P.H.Lond., 157

Observations, anatomical, on yellow fever problem in Africa, 69
Oils, prevention and treatment of cholera by essential, 210

ORIGINAL COMMUNICATIONS:—

Anatomical observations on yellow fever problem in Africa, 69
Airplane dusting in control of malaria mosquitoes, 311
Ankylostomiasis: comparative efficiency of carbon tetrachloride, chenopodium and thymol in treatment of hookworm infection, 101
Bilharzia problem in South Africa, 177
—— treatment. Experience gained from more than 3,000 tartar emetic injections. Precautionary measures. Results obtained, 4
Brief note on biochemical reactions of certain fungi, viz., *Monilia krusei*, *M. macedoniensis*, and *M. tropicalis*, 47
—— —— —— morphology, cultural characters and biochemical reactions of *Vibriothrix zeylanica* Castellani, 371
Broncho-spirochætosis, 360

ORIGINAL COMMUNICATIONS—*continued.*

Cancer of stomach of wild rat and infection with nematode worm, *Hepaticola gastrica* Baylis, 1925, 288
Cause of hairlessless of man, 313
Cauterization of adhesions in artificial pneumothorax treatment of pulmonary tuberculosis. Technique and indications, together with a survey of results obtained, 327
Concerning the discovery of plague bacillus, 299
Contribution to study of pathogenesis and treatment of sea-sickness, 59
Entomological notes with cancer field commission in Trentino, 1925, 294
Environmental influences which favour development and spread of bilharzia parasite in South Africa. Food supply of "Physopsis," 89
Epidemic of cholera amongst ballast train coolies in Bengal, 196
Epidemiological study of leishmaniasis visceralis in Spain, 387
Examination of cancerous and other tumours in animals collected by Dr. Sambon during his recent researches, 298
Final report on treatment of trypanosomiasis in Uganda, 85
Further experiments with *Gongylonema* of cattle, 194, 346
—— observations on mycological method to identify various sugars and other carbon compounds, 201
—— report on acquired immunity to malarial inoculation, 48
—— researches on the preservation of insulin, 1
Hookworm control with chenopodium-carbon tetrachloride, 227
Infectious jaundice in Sudan, 359
Influence of acid reaction on virus of chicken sarcoma (Rous) and its importance in experiments of Dr. Gye, 159
Leprosy in fourteen months old child, 146
Leptospira: methods of examination: new habitat of free-living forms, 170
Malaria in West Africa in 1893, 70
Morphological and cultural investigation of *Vibriothrix zeylanica* Castellani, 44
New species of *Hepaticola* (nematoda) from rat's stomach, 226
Note on corneal ulcer in malaria, 3
—— —— further experiences of use of Panama hat in Tropical Africa, 303
Notes on analysis of sprue stools, 169
—— —— case of bronchomycosis, 145
—— —— mycology, 291
—— —— use of eserine in glaucoma, 303
Observations and researches on epidemiology of cancer made in Holland and Italy (May-September, 1925), 233
—— —— importance of symbiosis or close association of different species of organisms in production of certain biochemical phenomena and in causation of certain diseases and certain symptoms of disease, 217
Preliminary note on study of *Endamœba blattæ* (Butschli, 1878), Leidy, 1879, found parasitic in intestine of *Blatta orientalis* in England, with some remarks on its generic status, 41
Prevention and treatment of cholera by essential oils, 210
Protection of the head against the sun's rays in Tropical Africa, 2
Refutation of statements made by Prof. R. T. Leiper, M.D., D.Sc., F.R.S., concerning African schistosomes, "American" gongylonemas, zoo vermin and Italian houses, 314
Remarks on Clayton-Lane's criticism of my monograph on malaria and blackwater fever in *Tropical Diseases Bulletin*, 1925, vol. 22, No. 4, p. 338, 89

ORIGINAL COMMUNICATIONS—*continued.*

Search for more efficient prophylaxis against tuberculosis, 53
Simian journalism, 335
Some aspects of malaria control, 185
Studies in vaccinia variolæ, 122, 133
Subacute inguinal poradenitis, or climatic bubo, 103
Tropical typhus and Brill's disease, 374
Variations in the virulence and in the morphology of certain laboratory strains of *Trypanosoma gambiense* and *Trypanosoma rhodesiense* isolated from human cases, 403
Virus diseases of bacteria, plants and vertebrates, 17
Whittingham (W.) strain of artificially induced malaria, 117
Yellow fever control in West Africa, 349

P

Panama hat in Tropical Africa, note on further experiences of use, 303
Pathogenesis and treatment of sea-sickness, contribution to study, 59
Pathology of central nervous system in malignant tertian malaria, observations, with remarks on certain clinical phenomena, 343
Plague bacillus, concerning the discovery, 299
Plants, bacteria and vertebrates, virus diseases, 17
Poradenitis, subacute inguinal, or climatic bubo, 103
Precautionary measures. Results obtained. Bilharzia treatment. Experience gained from more than 3,000 tartar emetic injections, 4
Preservation of insulin, further researches, 1
Prophylaxis against tuberculosis, search for more efficient, 53
Pulmonary tuberculosis, cauterization of adhesions in artificial pneumothorax treatment, 327

R

Report, final, on treatment of trypanosomiasis in Uganda, 85
—, further, on acquired immunity to malarial inoculation, 48

REPORT :—

Malaria-control in Ceylon plantations, 150

REPRINT :—

Puru of Malaya : its treatment and eradication, 81

Researches, examination of cancerous and other tumours in animals collected by Dr. Sambon during his recent, 298
—, further, on preservation of insulin, 1
Results obtained. Bilharzia treatment. Experience gained from more than 3,000 tartar emetic injections. Precautionary measures, 4

REVIEWS :—

Bacteriology, clinical and applied, manual, 167
Bats, mosquitoes, and dollars, 68
Biology of protozoa, 402
Bureau of Hygiene and Tropical Diseases, 52
Department of Health Malaria Research Unit, Haifa, annual report, 1923, 67
Elementary course in tropical hygiene, Part I, 67; Part II, 116
Handbook of tropical diseases, 68
Health of workers, 156, 386
Horse-fly : its life-history, importance as disease carrier, and practical measures for its suppression, 168
Localizzazione dei centri corticali per movimienti laringei, 156
Malaria, engineer and prevention, 167
—, war against, 52
Manual of emergencies, 115
Medical education. A comparative study, 68

REVIEWS—*continued.*

Memoria de la campaña contra el paludismo (1923-1924), 116
Merck's report on recent advances in pharmaceutical chemistry and therapeutics, 1917-1921, 116
Midwifery, textbook for medical schools and colleges in India, 168
Nematoda, synopsis of families and genera, 168, 370
Parasitology of man, manual, 370
Proceedings of the International Conference on Health Problems in Tropical America (held at Kingston, Jamaica, B.W.I., July 22 to August 1, 1924), 68
Protozoology, 340
Report of Secretary of State for Colonies on outbreak of plague in Gold Coast Colony and Ashanti, 156
—— to Secretary of State for Colonies on outbreak of plague in Gold Coast Colony and Ashanti, 386
—— —— —— —— —— sanitary condition of mines and mining villages in Gold Coast Colony and Ashanti, 116
Snake poisoning and observations on neo-tropical pit-vipers, general consideration, 232
Some developments of Harvey's doctrine "Omne vivum ex ovo" : being the Harveian Oration delivered before the Royal College of Physicians of London on October 19, 1925, 386
Yatren 105 in treatment of amœbic dysentery, 167

S

Sambon, Dr., examination of cancerous and other tumours in animals collected during his recent researches, 298
Sea-sickness, contribution to study of pathogenesis and treatment, 59
South Africa, bilharzia problem, 177
—— ——, environmental influences which favour development and spread of bilharzia parasite. Food supply of "Physopsis," 89
Spain, epidemiological study of leishmaniasis visceralis, 387
Sprue stools, notes on analysis, 169
Statements made by Prof. R. T. Leiper, M.D., D.Sc., F.R.S., concerning African schistosomes, "American" gongylonemas, zoo vermin and Italian cancer houses, refutation, 314
Stomach, cancer, of wild rat and infection with nematode worm, *Hepaticola gastrica* Baylis, 1925, 288
Study of pathogenesis and treatment of sea-sickness, contribution, 59
Sudan, infectious jaundice, 359
Sugars and other carbon compounds, further observations on mycological method to identify various, 201
Sun's rays in Tropical Africa, protection of head against, 2
Symbiosis, observations on importance, or close association of different species of organisms in production of certain biochemical phenomena and in causation of certain diseases and certain symptoms of disease, 217

T

Tartar emetic injections, experience gained from more than 3,000. Precautionary measures. Results obtained. Bilharzia treatment, 4
Thymol in treatment of hookworm infection, ankylostomiasis : comparative efficiency of carbon tetrachloride, chenopodium and, 101
Treatment of sea-sickness, contribution to study of pathogenesis and, 59
—— trypanosomiasis in Uganda, final report, 85
Trentino, entomological notes with cancer field commission, 1925, 294
Tropical Africa, note on further experiences of use of Panama hat in, 303
—— ——, protection of head against sun's rays, 2
Trypanosomiasis in Uganda, final report on treatment, 85
Tuberculosis, search for more efficient prophylaxis against, 53

Tumours, examination of cancerous and other, in animals collected by Dr. Sambon during his recent researches, 298
Typhus, tropical, and Brill's disease, 374

U

Uganda, final report on treatment of trypanosomiasis, 85
Ulcer in malaria, note on corneal, 3
Use of eserine in glaucoma, notes, 303
—— Panama hat in Tropical Africa, note on further experiences, 303

V

Vaccinia variolæ, studies, 122, 133
Variations in the virulence and in the morphology of certain laboratory strains of *Trypanosoma gambiense* and *Trypanosoma rhodesiense* isolated from human cases, 403
Vertebrates, virus diseases of bacteria, plants and, 17
Vibriothrix zeylanica Castellani, brief note on morphology, cultural characters and biochemical reactions, 371
—— —— ——, morphological and cultural investigation, 44
Virus of chicken sarcoma (Rous), influence of acid reaction, and its importance in experiments of Dr. Gye, 159

West Africa, malaria in 1893, 70
—— ——, yellow fever control, 349
Wild rat, cancer of stomach, and infection with nematode worm, *Hepaticola gastrica* Baylis, 1925, 288

Y

Yellow fever problem in Africa, anatomical observations, 69

LIST OF PLATES.

Observations on pathology of central nervous system in malignant tertian malaria, with remarks on certain clinical phenomena, Plates I and II, 344
Preliminary note on study of *Endamœba blattæ* (Butschli, 1878) Leidy, 1879, 43
Vibriothrix zeyanica Castellani (2 plates), 46

INDEX OF SELECTIONS FROM COLONIAL MEDICAL REPORTS.*

GENERAL INDEX.

(186) Bengal (*continued*), 1, 5, 9, 13
(187) Cairo, 13
(188) Madras, 15, 17, 21
(189) Bihar and Orissa, 22
(190) Bihar and Orissa, 23
(191) New Zealand, 25, 29, 33, 37
(192) Trinidad and Tobago, 39, 41
(193) Ceylon, 43, 45, 49, 53, 57, 61
(194) Egypt, 62, 65, 69
(195) Sierra Leone, 69, 73, 77
(196) Nyasaland Protectorate, 77, 81, 85
(197) Trinidad and Tobago, 87
(198) Trinidad and Tobago, 88
(199) Cairo, 94
(200) Bengal, 95

* *Note to Binder.*—These are to be bound to follow the last number in the volume of the JOURNAL OF TROPICAL MEDICINE AND HYGIENE.

Original Communications.

FURTHER RESEARCHES ON THE PRESERVATION OF INSULIN.

By Prof. E. Trocello
AND
Dr. A. Cruto.

In a communication to the XXXth Italian Congress of Internal Medicine [1] we minutely described some of our experiments on the resistance of insulin at high temperature. We were induced to carry out these experiments by some communications published by English authors, who, having used insulin of a different origin, had noticed that it lost its medical power in tropical climates, so that after a few months the deterioration practically rendered the drug useless.

The conclusions of our experiments carried out with Italian insulin, were as follows:

The insulin, kept constantly at high temperature, even for a long time, maintains its hypoglycæmic property integrally, or remarkably well.

The preparation kept in solid form shows itself incontestably more resistant than insulin in liquid solution. In fact, in the experiments at 100°, for twenty-four hours, and in the experiments at 42° for thirty-five days, the property of the former was in no way modified, while the latter lost about one-half of its hypoglycæmic property and did not cause convulsions. Another consideration on the resistance of the experimented insulin, is the length of its duration at a high temperature. The solid preparation, in this respect, in the limited time of the experiments (twenty-four hours at 100° and fifteen and thirty days at 42°) did not undergo any alterations at all. Insulin in solution form appeared to be peculiarly influenced by the time of the exposure; in fact, while it resisted integrally the temperature of 100° for ten hours, it lost about one-half of its hypoglycæmic power, both at the temperature of 100° in twenty-four hours and at a temperature of 36° in sixteen and thirty-four days. In consequence, we get the following practical corollary in relation to the preservation in tropical climates of insulin experimented with by us: The possibility of preserving the original hypoglycæmic properties even at very high temperature and for a considerable length of time.

These experiments were carried out with "Insulin Ergon" prepared in the Instituto Nazionale Medico Farmacologico of Rome.

Nevertheless, the important problem of the preservation of insulin in tropical climates could not remain unsolved, and last year new experimental laboratory investigations were carried out, especially by English authors in India.

These investigations appeared particularly necessary as some clinical results seemed to strengthen the idea of quick deterioration. In fact, Stott [2], in India, had met with a progressive loss of activity in twelve diabetics when the drug was kept at room temperature. When the medicament arrived in India it possessed a glucosic equivalent of 12 gr. per unit and gradually went down to 1 gr. or less, in six months.

It is true that other authors come to different conclusions. For instance, Bose [3] has been able to observe in India, that at a temperature of 35° for one month, insulin did not undergo any deterioration at all.

In a more recent paper, in *The Lancet*, Neave Kingsbury [4] exposed a succession of experiments carried out with American insulin on rabbits of different origin. He concluded that a sample of insulin kept at tropical temperature for six months, and injected into local rabbits, seemed to immediately undergo a deterioration of about 40 per cent. On reckoning the results obtained on rabbits of first generation and originating from animals recently imported into the tropics, showed but little or no deterioration.

Moreover, the author draws some conclusions on the factors which would have an influence on the preservation of the drug, and attributes them to the purity of the preparation and the acidity of the insulin solution; this, besides the mentioned importance on the variety of the animals used for controls.

Our new researches were carried out on samples which had previously appertained to the preparation used last year for the first experiments.

A.—Insulin kept in Incubator at 42° for three months.

Experiment No. I.

Solid Insulin.

(January 7, 1925.) Rabbit ♂, weight 1,730 grm.
Time, 9.25, injection of 2 mg. of insulin
,, 11.10, typical convulsions
,, 11.15, glycæmia = 0·44 per thousand

Experiment No. II.

Insulin in Solution.

(January 7, 1925.) Rabbit ♂, weight 1,400 grm.
Time, 9.30, injection of 0·3 c.c. (10 units per c.c.)
,, 11.30, glycæmia = 0·81 per thousand
No convulsions.

B.—Insulin kept in Incubator at 37° to 40° for one year and twenty days.

Experiment No. I.

Solid Insulin.

(October 28, 1925.) Rabbit ♀, weight 1,510 grm.
Time, 9.15, injection of 2 mg. of insulin
,, 11.25, glycæmia = 0·50 per thousand
,, 13.45, typical convulsions

Experiment No. II.

(October 29, 1925.) Rabbit ♂, weight 1,800 grm.
Time, 11.55, injection of 2 mg. of insulin
,, 14.15, glycæmia = 0·47 per thousand
,, 14.20, typical convulsions

Experiment No. III.

(October 29, 1925.) Rabbit ♂, weight 1,430 grm.
Time, 12, injection of 2 mg. of insulin
,, 14.20, glycæmia = 0·53
,, 15.30, typical convulsions
,, 15.35, glycæmia = 0·42

Therefore, we may conclude that:

The insulin experimented with by us and kept in solid form in incubator at 37° to 40° for more than a year, retains the hypoglycæmic property which it had soon after its preparation, and its power of causing convulsions.

At high temperature, if suitably prepared and preserved in solid form, insulin remains unaltered.

On the other hand, kept in liquid solution, the insulin shows a loss of about one-half of its power already after thirty-three days (42° to 45°), and after three months (42°) a nearly complete abolishment of the hypoglycæmic properties and a total disappearance of the convulsive ones.

Relating to the results of Cheadle [5] on the influence of the acidity of the insulin solution, some other considerations can be made. Cheadle has proved that in autoclave at 125° for twenty minutes, the solution with pH=2 would lose 20 or 25 per cent. of its power, while that with pH=4 would lose it completely. And such phenomena would appear to relate to a disassociation by the product, if kept in solution.

The preservation of the solid form, if the hypothesis be true, appears to be the most indicated.

In any case, the fact is that neither high temperature nor time has any influence on the biological properties of the drug kept in solid form. Further, that the age and origin of the animals used for insulin properties have rather a great importance and give reason for the different results obtained by various authors, cannot be rejected by anyone.

Also in our temperate climates some differences, not very important ones, can be observed between rabbits of different breeds. From this arises the corollary that only animals recently imported from temperate climates should be experimented with in the tropics.

As regards the other consideration of Neave Kingsbury, on the purity of the product, which would give reason to the fact that, in tropical climates, some preparations keep better than others, it can be observed that there is not anything more likely. The fact of maintaining itself better in solid form than in liquid solution strengthens the hypothesis and proves the easy susceptibility of the product to impurity of all kinds.

SUMMARY.

Insulin should be kept in solid form because, as shown by experiments, it does not undergo any alteration at a high temperature, and can be preserved for an unlimited length of time. The cause of the difference in preservation of insulin in liquid form lies in the fact that a hydrolysis of the product causes a deterioration in its pharmaco-dynamic properties.

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THE PROTECTION OF THE HEAD AGAINST THE SUN'S RAYS IN TROPICAL AFRICA.

By J. F. CORSON.

IT is very generally believed by European residents in tropical Africa that exposure of the head to the sun's rays for even a brief period, unless protected by an opaque covering, is likely to cause not merely discomfort but serious results. A chink in the grass roof of a hut, or the admission of a few rays of light through the ventilation aperture of a "Wolseley" helmet is regarded with misgiving. The supposed harmful influence is often attributed to penetrative power of light rays or ultra-violet rays rather than to heat. Manson suggested that some peculiar physical action of the sun's rays on the tissues might be the cause of that class of cases called sun-traumatism. It appears to be established, from numerous observations, that the sun's rays of short wave-lengths have very little penetrative power, hardly, if at all, beyond the skin. There is no reason to suppose that the scalp may be different from other parts of the skin in regard to the possible formation of chemical substances by the action of rays. It appears also to have been shown conclusively that heat-stroke is due to overheating of the body associated with failure of the natural heat regulation. Local heating of the central nervous system to a harmful degree is theoretically possible, but is unlikely to occur without a corresponding greatly increased temperature of the skin and subcutaneous tissues. Temperatures of 109·4° F. to 111° F. have been observed within helmets without apparently causing discomfort to the wearers (Wanhill, quoted by L. Hill). There is no doubt that a light, white helmet fulfils the requirements of great reflection and little penetration and provides a moderate degree of ventilation. A helmet, however, at its best is a heavy and clumsy form of hat and is discarded with relief when it is thought safe to do so. A few somewhat rough experiments were made in Dar-es-Salaam during the months of August, September and October, 1925, to see whether some lighter head covering might safely be used. A Panama hat was selected as a possible suitable substitute. Some tests were made to compare the heat-excluding qualities of some forms of hat, viz., a man's white "polo" helmet, a lady's white pith helmet, a Panama, a man's soft dark-grey felt hat, a lady's light-grey tropical hat of thick felt and a red fez with loose black calico lining. The conditions were not severe as regards heat rays as the maximum shade temperature during the period was only 86° F. to 88° F. and a fairly strong breeze was usually present. Exposures to the sun for various periods and at different heights from the ground were made, clinical and other thermometers being used to record the maximum temperatures inside the hats. The results were in accord with similar experiments by various observers. The felt hats and the fez showed high temperatures, 105° F. to 112° F., with exposures of from ten minutes to half an hour and longer, whilst the thermometers inside the helmets never

rose above the original setting of 97° F. or 98° F., and the Panama rarely showed a temperature above 100° F. under similar conditions. The lady's felt hat, a heavy article said to be intended for use in the tropics, showed an inside temperature of 108° F. after exposure for two hours. Using the man's felt hat to represent the scalp, the temperature of its upper surface, when covered by the Panama, rose to 100° F. with one hour's exposure and on another occasion to 102·2° F. with four hours' exposure at the hottest part of the day. Some personal experiments were also made. With the bulb of the thermometer in contact with the parietal region of the scalp, five minutes' exposure, when wearing the felt hat, raised the temperature to 102·4° F., whilst when the Panama was worn, an exposure of forty minutes, from 11.50 a.m. to 12.30 p.m. caused a rise to 99° F. only. On the afternoon of the same day, the Panama being worn with continuous exposure from 2.30 p.m. to 4 p.m., the temperature of the scalp, tested from time to time, was only 99° F. On one occasion the bare head was exposed to the sun from 2 p.m. to 2.30 p.m. The temperature of the scalp or hair, taken by stroking with the bulb of a clinical thermometer, rose to 104° F. within six minutes, and to 105·1° F. in twenty minutes, and did not rise higher. The temperature of the body, taken in the mouth, did not rise above normal within an hour. Except for the tingling feeling of radiant heat during the half hour, which was most felt in the first few minutes, no discomfort was experienced either at the time or later. The dry bulb temperature at the time was 82·7° F., the wet bulb 77·3° F., and the maximum temperature of the day 88·8° F. There was a moderate breeze. Throughout the period from August to October the Panama hat was used instead of a helmet. On several occasions there was continuous exposure to the sun throughout the afternoon from 2.30 p.m., though the conditions of daily work usually involved very brief periods of exposure. No unpleasant symptoms were experienced.

Conclusions.

(1) Under the mild conditions that prevail for considerable periods of the year in many parts of tropical Africa, a light form of hat with good reflecting power, such as a Panama, may safely be used instead of a helmet, at least when the circumstances of daily life do not require prolonged exposure to the sun.

(2) While such states of bodily health and such external conditions as are known to conduce to over-heating of the body with diminished heat loss, should be guarded against, there is a tendency to attach an exaggerated value to the penetrative power of the sun's rays in tropical Africa.

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A NOTE ON CORNEAL ULCER IN MALARIA.

By R. E. McConnell, B.A., M.D.,

and

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Statistics on the subject of corneal ulcer as a complication of malaria are not available here, but it must be relatively uncommon as in a contact with some thousands of cases in various parts of the world I had not met with any until the case under present consideration. The only intrinsic interest in this case is that the patient developed malarial symptoms only twice in his life, and on both occasions this complication presented itself. The description of the first attack is from the hospital records augmented by recollections of those in attendance.

R.W., a robust Canadian of 46 years, was admitted to hospital April 28, 1924, with a high temperature and typical symptoms of malaria. A thin blood-smear was negative, but the clinical symptoms pointed to the infection being that of malignant tertian. On the third day, when the temperature had fallen to normal, what was originally diagnosed as severe conjunctivitis appeared in the right eye. For several days there was considerable pain in the eyeball. A transparent, faintly grey ulcer was then found below the pupil, which later became lead-coloured for a time. It grew larger by budding. Boric acid washes were first used, then procaine and argyrol for some days and then again boric acid, with the silver compound every third day. The eye was padded. By May 16 the conjunctival injection had cleared up. On July 10 he was sent to New York on account of the anxiety

caused by the persistent macula, but by the time he arrived there he was pronounced by a specialist fit to return at once. The macula subsequently cleared up completely.

On September 3, 1925, he was admitted again under the immediate care of Dr. R. H. Eisaman, and showed malignant tertian parasites. He was discharged on the 9th. On the 11th the right eye began to trouble him while on night duty and in the morning he noticed that vision was dimmed. The eye became very red and painful and by next day was at its worst. There were pain and photophobia. He came into the hospital on the 19th, when an irregularly round almost transparent ulcer a quarter-inch in diameter was found, paracentral, a little below and to the inner side of the pupil. Both palpebral conjunctivæ were very red, while the circumcorneal injection was faint and confined to a narrow band. The ulcer was touched twice with ionine, atropine instilled twice, a shade applied and on the 24th he was discharged with no sign left other than a slight unevenness of the surface where the ulcerous area had been.

I think it is safe to assume that both of these eye attacks were herpetic. No other herpetic eruption manifested itself. It seems probable that in these cases a guiding treatment is preferable to one of energetic medication and interference.

BILHARZIA TREATMENT. EXPERIENCE GAINED FROM MORE THAN 3,000 TARTAR EMETIC INJECTIONS. PRECAUTIONARY MEASURES. RESULTS OBTAINED.[1]

By Dr. P. H. J. Lampe,

Surgeon to the Dutch East-Indian Army, Paramaribo.

For many years it has been customary in the Military Hospital of Paramaribo to treat certain tropical diseases such as venerial granuloma, leishmaniasis, bilharziasis, filariasis and some cases of ulcera cruris, with intravenous injections of tartar emetic.

The results obtained were—with the exception of some cases of venerial granuloma and leishmaniasis—only relatively satisfactory. The curative value of this remedy was therefore accepted by the medical men of this Institute with reserve. Moreover, often undesirable, sometimes dangerous complications were observed.

My personal experience during 1923 and 1924 (which included many cases of leishmaniasis, filariasis, bilharziasis and ulcera cruris) made me doubt the specificity of this remedy.

Reading the literature, however, made it at once become plain to me that unfavourable results—especially in bilharziasis, so flagrantly in contrast with the results obtained in Egypt, South Africa, China and Japan—were undoubtedly due to the too small doses given in this country.

Of late years a copious literature bearing on bilharzia treatment has accumulated. Those interested I may refer to the list at the conclusion of this communication.

Briefly the conclusion arrived at is that tartar emetic—provided necessary precautions are observed and a sufficient dose is given—will cure every bilharzia patient of his parasitism, without appreciable harm, with the exception of a few cases showing intolerance.

According to Christopherson, the recognized authority, a dose of 25 to 30 gr., i.e., + 1·620 to 1·950 grm. of tartar emetic within twenty-five to thirty days intravenously injected is sufficient (*Lancet*, September 7, 1918; *Journal of Trop. Med. & Hyg.*, July 1, 1920; my own correspondence, 1925).

It might be expected that the application of these large quantities of tartar emetic in a relatively short period would emphasize the complications so often observed.

Since it was thought possible that these ill results were due to impurities, the miltary apothecary Vonk analysed the whole quantity of tartar emetic in stock for possible impurities.

The report of this analysis, of considerable value to successful tartar emetic therapy, follows:—

"In connection with a communication of Meleney ('Schistomiasis japonica,' *United States Naval Med. Bull.* 881, No. 5) that Christiansen and Norten ('Some Observations on Tartar Emetic,' *Journ. Lab. and Chin. Med.*, 1923, ix, 35) are drawing attention to the fact that most of the tartar emetic appearing on the market for medical use contains lead, arsenic and iron as impurities, beside the insoluble and poisonous antimonium-oxide, the consignments of tartar emetic then present in the store of the Military Hospital were examined for these impurities.

"The consignments were received in 1905, 1911, 1916, 1924 and 1925.

"All were obtained from the Government magazine of chemicals at Amsterdam.

"It appeared that only the consignment of 1916 was pure. Besides a trace of chloride, that of 1915 contained a trace of chloride and also a trace of heavy metal; and that of 1911 had, moreover, a trace of sulphate. The solution of the consignment of 1924 was turbid and yellowish, and contained heavy metal as well as potassium hydrotartrate.

"The solution of the consignment of 1925 was dark yellow, contained plentiful sulphate, some potassium hydrotartrate and also a trace of chloride and heavy metal.

"The older consignments were in fact of a better quality. By repeated recrystallization, aided by strong suction, a preparation was got that answered the analytical (value determination) as well as the following tests, to which, in my opinion, *tartras kalio-stibicus pro injectio* should be put.

"These tests are obtained partly from the Dutch

[1] Communication from the Military Hospital of Paramaribo, by Chief P. Cool, Surgeon-superintendent to the Dutch East-Indian Army.

Pharmacopœia and partly from E. Schmidt's 'Pharmaceutische Chemie.'

"The 5 per cent. solution should be perfectly clear and colourless; neither barium nitrate, silver nitrate, nor ammonium oxalate should cause in this solution a precipitate or an opalescence within five minutes.

"When to a solution in concentrated hydrochloride acid, 1 gr. to 4 c.c., an equal volume of stannochloride is added, the liquid should not become turbid or discoloured.

"The 5 per cent. solution should, if mixed with an equal volume of 1/10 N thiosulphate, remain clear for at least five minutes at a temperature of 25° C. When to 5 c.c. of the 5 per cent. solution be added so much pure nitrium hydroxide solution, so as entirely to redissolve the precipitate at first appearing, the addition of concentrated hydrosulphide solution should cause neither precipitate nor discoloration.

"The present Dutch Pharmacopœia does not mention tests in relation to clearness and colourlessness of the solution, does not demand the absence of calcium and heavy metals, and prescribes a reaction on chloride and sulphate in a solution of 1 per cent. (see Schoorl, Ph.W., '07, 1020 and 0'4, 866).

"The perfectly pure tartras kalio-stibicus is nowadays dissolved, 1 to 100, in a solution of 0'7 per cent. NaCl *purissimum*, filtered through wet, hardened filter-paper and, as shortly as possible before the injection, sterilized for a full hour in a vapour current of 100° C.

"The solution is then contained in nearly fully filled vials with ground-stoppers, tied up with paraffin paper."

For bilharzia treatment the tartar emetic purified in the above manner has been used since January, 1925, and the 1 per cent. solution in physiological solution is prepared and sterilized the night before each injection day as late as possible.[1]

During the treatment the urine is regularly tested for albumin and casts. The patients have always to report all symptoms experienced after the injection (coughing, vomiting, pain in the muscles or joints, fever, ague, headache, short-windedness, palpitations, itch, eczema (eruption), œdema, &c.), and also diseases (malaria, filaria, bronchitis, angina, &c.). Symptoms however mild should be noted.

Every item is noted on the patient's case sheet, so that the dose injected may be reduced or the injection suspended. The patient remains seated under observation for a quarter or half an hour. After this rest the patient can take the often long homeward journey without inconvenience. The most seriously infected area is at about two hours' walk from the Military Hospital.

The routine treatment of bilharzia patients is:—

Thrice a week, after three injections of 3 c.c., 5 c.c. and 7'5 c.c. respectively, 8 to 10 c.c. of 1 per cent. tartar emetic solution is injected up to a total of 150 to 200 c.c.

Treatment takes about six to seven weeks. Adults in less favourable health condition (chronic malaria, anæmia, touch of cachexia, &c.) receive proportionally less. Children aged 12 years receive 100 to 125 c.c., 5 to 6 c.c. each injection; children of 8 years, 80 c.c., 3 to 4 c.c. each injection.

The clinical treatment of in-patients—excepting serious cases of lung and hepatic disorders—is somewhat altered.

These patients, under regular control and not working, get 8 to 10 c.c. six times weekly, after three preceding injections of 3'5 and 7'5 c.c., and are injected with a total quantity of 200 to 240 c.c.

Treatment in such cases lasts from four to five weeks. This undoubtedly "very strong tartar emetic treatment"—50 to 60 c.c. of the purified solution injected weekly—was, without exception, easily borne by all the patients (fourteen adult males, negroes and creoles). To Javanese and Hindoos this intensified treatment was, as a rule, not applied.

Regular notes was kept of all possible disturbances occurring during and after the treatment:—

(i) *Rheumatic pains.*—Many adult patients (75 per cent.) suffered from slight rheumatic pains in the muscles and the main joints; about 30 per cent. complained of their own accord. All of them, however, could uninterruptedly continue their occupations in the field, although a few may have ceased coming for treatment on that account.

These pains mostly appear the day after the final injection and may last to the next day. It is most interesting that I never heard any such complaint from children, not even after having asked (sixteen patients of less than 14 years), who receive relatively more tartar emetic than the adults.

(ii) *Tussicular irritation.*—This was fairly regularly observed in the case of four patients (amongst whom were two children), immediately after each injection. A slight reduction of the dose, and eventually a small dose of codeine, helped excellently.

(iii) *Inclination to vomit.*—In the case of a patient (adult male) this occurred so regularly that the dose per injection had to be reduced to 5 c.c. and the total dose to 100 c.c. Notwithstanding that, this patient, whom I had been able to control regularly since discharge from the hospital, is permanently cured. The parasites have apparently suffered more than the patient (? retarded excretion, ? higher concentration in the blood). The inclination to vomit now and then was easily overcome in the case of six adults. One patient vomited after the first injection (3 c.c.) and was not further kept under treatment.

(iv) *Salivary flux.*—Once observed.

(v) *Headache* (without albuminuria).—Two females complained of this during the treatment. One female still complains of headache (four months after discharge) and blames the treatment for that (albumin −, *Ankylostoma* +).

(vi) *Œdema* (without albuminuria).—Thrice a localized œdema was observed, twice on the volar

[1] The use of tartar emetic from a vial that has been opened has to be warned against. It appears that, even in observing the ordinary aseptic precautionary measures, infection may be brought about by fungi, for which this solution is an excellent nutrient.

part of the hand and wrist (one-sided), once on lips and chin. It was a passing and painless swelling, lasting only a few days.

(vii) *Albuminuria*, not observed before, was observed in the case of a female patient after the



FIG. 1.—Clinical case of native with *Schistosoma mansoni*. Wasting of face and body. Much ascites due to cirrhosis of liver and miliary bilharzial peritonitis. Œdema of lower extremities.

administration of a total dose of 120 c.c. She had no other complications. Esbach varied from ½ to 1 per cent., and hyaline cylinders were found in the sediment.

(viii) *Itching, urticaria, pustulous eczema.*—Especially on the extensor side of the extremities, sometimes over the entire body. Itching was repeatedly met with; urticaria as well; in the case of three adults an at first persistent eczema appeared, slowly improving during the continued treatment. These symptoms appeared "only after the final injections."

(ix) *Fever, ague.*—It is not possible to decide whether fever and ague, often observed, are always due to malaria, filaria, &c., or whether they are due to the tartar emetic.

(x) *Icterus.*—A slight icterus, lasting five weeks, occurred in a patient three weeks after the treatment (220 c.c.). The patient suffered at the same time from fever and his blood harboured malaria plasmodia.

(xi) *Short-windedness, cardiac pains, palpitation.*—Observed in slight degree in one male and one female.

(xii) *Collapse.*—Only three times experienced in the case of anæmic patients, who had come a long distance; after the injection a faint of short duration and of not disquieting nature. Serious collapse never occurred.

In summing up it will be found that very often slight rheumatic pains appear, which are, however, so insignificant that even sensitive and easily complaining Hindoos can regularly carry on with their work during the treatment. Very seldom does it become necessary to stop the treatment on that account, injections being looked upon as quite an ordinary affair and have become even popular.

With children no undesirable complications, except the cough, immediately after the injection, have been noticed.

My expectation that certain agricultural centres in Surinam would prove seriously infested, is unfortunately true.

The fæces of 434 settlers of Kwatta chosen at random (district in the immediate neighbourhood of the city) were sent for examination. The conscientious control by the landowner guaranteed reliability.

Ninety-one of the 242 male Hindoo peasants were infected, 9 of the 37 female, 5 of the 153 children.

Of 68 people of Meerzorg collected at random, all peasants, 32 were infected. A small number of women and children investigated were not infected.

Later on I hope to examine further this district lying opposite Paramaribo city on the right bank of the Surinam river.

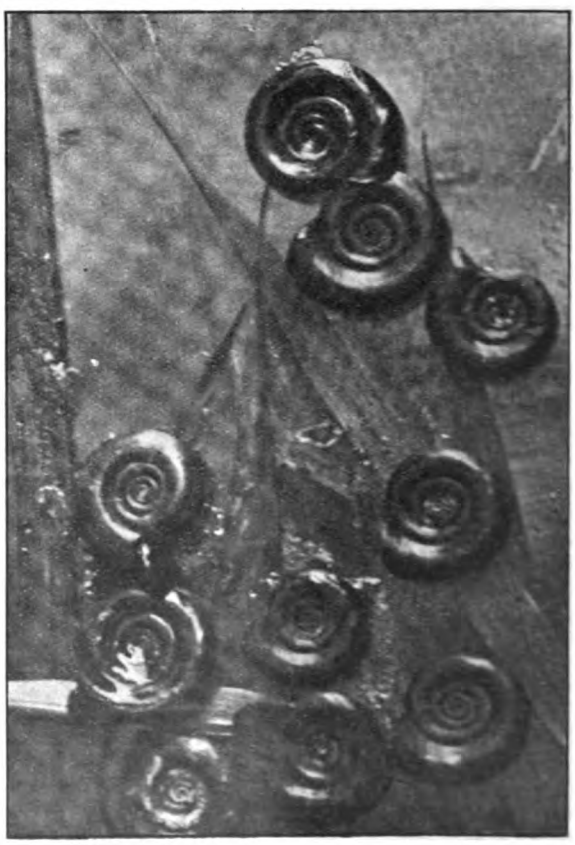


FIG. 2.—Photograph of shells of *Planorbis olivaceus*, the immediate host of *Schistosoma mansoni* in Dutch Guiana.

Thirty-one of 62 inhabitants of Charlesburg, an outlying quarter of Paramaribo, who for the greater part sent their fæces spontaneously for examination, were infected, viz., 21 out of 32 males, 3 out of 3 females, 7 out of 27 children.

In addition to these, 158 cases of bilharziasis came under my observation from January 1 to July 31; total in seven months, 326 cases.

My opinion is that practically all field labourers are infected in the endemic areas.

Simple examination of fæces can only partly disclose the number of infected. It often happens, after repeated, negative results, that bilharzia eggs are found at last. The examination of the fæces of labourers, regularly working under the same conditions on the same land where infested snails (14 per cent.) are met with, proved again and again that such examination gives positive results only for a percentage.

I have found living parasites in the portal vein, in cases which always presented negative results when their fæces were examined whilst in hospital. The same applied to patients in whom during a laparotomy typical bilharzial miliary peritonitis was encountered, without eggs having been found in the fæces.

Synopsis of Cases.

Of the 326 bilharzia patients, gathered from January to July, are:—

(*a*) 108 discharged, cured after a complete tartar emetic treatment.

(*b*) 4 discharged, after treatment with tartar emetic clysmata (infants, not allowing injections to be regularly applied).

(*c*) 1 discharged after treatment with emetine (serious arterio-sclerosis).

(*d*) 37 inadequately treated, viz., 2 on account of intolerance, 2 on account of disorders not due to the treatment and 1 on account of disorders due to the treatment. The others have untimely withdrawn from the treatment.

(*e*) 25 in polyclinical treatment on Monday, Wednesday, Friday.

(*f*) 25 in polyclinical treatment on Tuesday, Thursday, Saturday.

(*g*) 8 in clinical treatment.

(*h*) 3 not treated, viz., 1 on account of intercurrent disorders and 2 on account of serious bilharzia-cirrhosis of the liver.

(*i*) 6 died, 4 on account of serious bilharziasis of liver, lung and intestine.

(*j*) 109 untreated, will be gradually brought under treatment.

It is important to note that not one refused gratuitous treatment. The treatment has now become so popular that often Hindoos, male and female, sometimes with all their children, come long distances solely to be injected. In many cases they were satisfied to be treated when the examination of the fæces disclosed the presence of bilharzia eggs.

The results obtained with the intravenous application of tartar emetic are to be considered absolutely favourable. The fæces of nearly all the patients who have had five to six injections proved to be free from eggs with living miracidia, provided the treatment be not interrupted.

Only in a few cases the parasites or eggs were found more resistant, and ten to twelve injections were necessary to secure success.[1]

Of 24 patients long discharged, I was able to check the fæces for months (soldiers, personnel of the hospital and others), always with negative results.

[1] It is always necessary to find out whether an egg-case contains a miracidium or not. (Slight pressure on the cover-glass—eosin preparation.) Even after a successful treatment the egg-case, which is occasionally deposited in the intestinal wall, may appear in the fæces, sometimes accompanied by clinical symptoms (blood in the fæces).

	Race	Genus	Duration of the treatment	Total dose	Fæces permanently negative since	Control after discharge negative
1.	Br. Ind.	kind	7/2 - 28/2	125 c.c.	23/2	28/2 to Aug.
2.	Sur.	volw.	29/1 - 12/3	160 c.c.	12/2	12/3 ,,
3.	Br. Ind.	kind	3/2 - 19/3	130 c.c.	—	19/3 ,,
4.	Sur.	volw.	2/1 - 21/3	220 c.c.	12/2	29/3 ,,
5.	Sur.	volw.	24/1 - 24/3	175 c.c.	12/2	17/5 ,,
6.	Sur.	volw.	3/2 - 28/3	210 c.c.	—	30/3 ,,
7.	Br. Ind.	volw.	28/1 - 20/3	200 c.c.	23/2	20/3 ,,
8.	Br. Ind.	volw.	4/2 - 31/3	235 c.c.	—	30/3 ,,
9.	Sur.	volw.	29/1 - 4/4	210 c.c.	—	6/4 ,,
10.	Sur.	volw.	12/2 - 6/4	170 c.c.	—	6/4 ,,
11.	Sur.	volw.	21/2 - 6/4	190 c.c.	—	9/4 ,,
12.	Sur.	kind[2]	29/1 - 7/4	120 c.c.	4/3	7/4 ,,
13.	Sur.	volw.	29/1 - 7/4	160 c.c.	—	7/4 ,,
14.	Sur.	volw.	2/1 - 7/4	150 c.c.	—	7/4 ,,
15.	Sur.	volw.	29/1 - 7/4	200 c.c.	12/2	17/5 ,,
16.	Sur.	kind	21/2 - 16/4	100 c.c.	—	16/4 ,,
17.	Sur.	volw.	18/3 - 2/5	170 c.c.	—	2/5 ,,
18.	Sur.	volw.	24/3 - 7/5	205 c.c.	18/4	8/5 ,,
19.	Sur.	kind	14/3 - 8/5	100 c.c.	—	12/5 ,,
20.	Sur.	kind	14/3 - 8/5	100 c.c.	—	12/5 ,,
21.	Br. Ind.	volw.	14/4 - 11/5	170 c.c.	4/5	11/5 ,,
22.	Br. Ind.	volw.	1/5 - 20/5	120 c.c.	2/5	20/5 ,,
23.	Sur.	volw.	9/4 - 28/5	190 c.c.	28/4	28/5 ,,
24.	Sur.	volw.	11/4 - 30/3	190 c.c.	25/4	30/5 ,,

[2] The parasites were very persistent in this case. Only after sixteen injections the fæces were shown to be permanently negative. The same patient suffered on August 18 from an attack of acute colitis with blood in the fæces. Examination revealed the presence of many empty egg-cases and no living miracidia; on September 8 a second attack. Examination disclosed eggs with living miracidia. The possibility of a re-infection is naturally not excluded.

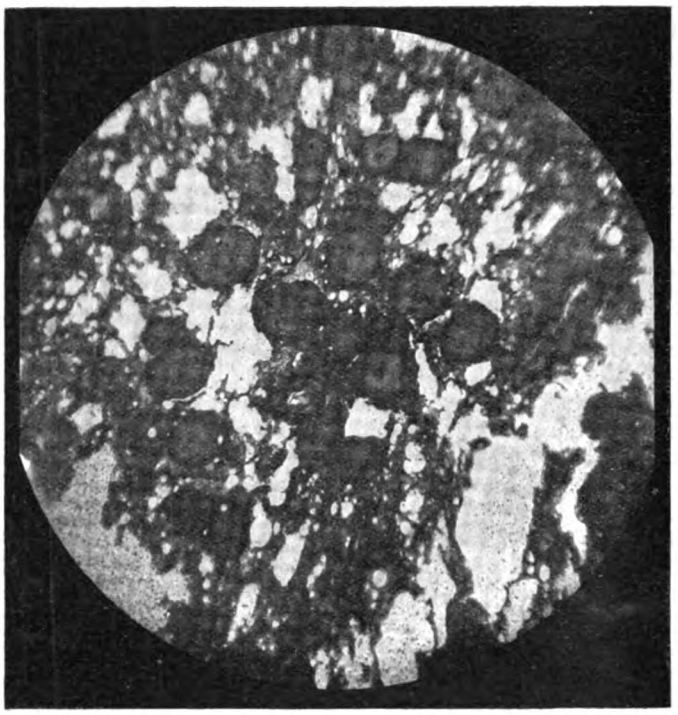


FIG. 3.—Photomicrograph of bilharziasis affecting lungs. *B. miliaris pulmonum.*

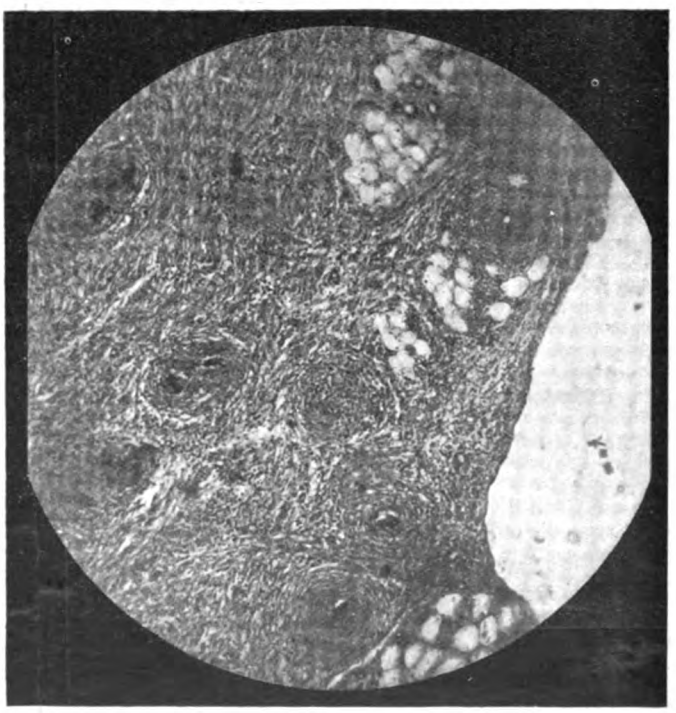


FIG. 4.—Photomicrograph of bilharziasis affecting the peritoneum. *B. miliaris peritonei.*

The duration of the control is as yet too short to allow a definite opinion to be expressed in connection with the applied treatment.

Judging from the negative results of all the controlling examinations, I believe that it will be proved later that all patients are permanently cured, i.e., that the applied doses and the subsequent concentration in the blood are certainly greater than the individually varying minimum necessary to kill all parasites and sterilize all eggs.

Different observations point to the fact that the necessary quantity of tartar emetic varies widely for different individuals, probably on account of the longer or shorter circulation in the blood.

The more ready excretion, the subsequent lower concentration in the blood would then explain the absolute absence of by-complication in children.

The less ready excretion and the subsequent higher concentration in the blood would then make intelligible the unfavourable results in the case of patients whose treatment had to be untimely stopped through interfering disturbances.

The question therefore arises, whether it may be considered right to inject all patients with the dogmatic dose of 200 *c.c., especially since tartar emetic cannot be looked upon as a harmless remedy.*

It would have been much better if a proper account could be made of the individual reaction.

The examination of the fæces does not afford the slightest warrant. In cases of rectal bilharzia (in total the minority) the examination of the rectum by means of the speculum or rectoscope is most important (Christopherson, by correspondence), but the mass-extermination of the parasites need not run parallel with the eventual curing of the local process.

About the complement-fixation reaction of Fairley becoming negative in cases of cured patients, I have no experience. According to Fairley, however, this reaction bears a similar relation to bilharziasis as does the Wassermann reaction to syphilis (*Lancet*, June 14, 1919), so that this also is not adequate for the immediate control of the dose of the tartar emetic.

It is therefore desirable to find a criterion, indicating for each patient the minimum therapeutic dose.

The regular examination of the blood-picture of a large number of bilharzia patients before, during, and after treatment has brought to light something that probably will enable us to determine this individually varying minimum.

It is proved that during the treatment—after a number of injections had not shown any influence—the already existing eosinophilia (+ 20 per cent.) increases to 50 to 80 per cent., only again to decrease, some time after the treatment has finished, to far below the original percentage.

A preliminary investigation has brought to light something to the same effect in the treatment of filariasis, but only when microfilariæ are present in the blood.

I am inclined to explain this eosinophilia as a phenomenon due to anaphylaxy, arising at the moment when a large number of parasites are destroyed.

A considerable quantity of "dead," extraneous "albumin" enters into the circulation of patients already possessing antibodies against that same extraneous albumin, in consequence of a preceding spontaneous destruction of a few parasites.

It is even probable that this supposed anaphylaxy gives an explanation of the fever, ague, itching urticaria, exanthema, local one-sided œdema, &c., so often observed during the treatment.

It is therefore highly inviting to speculate on the basis of a curve representing the eosinophilia after each injection or at the end of every week, on the possibility of the moment when the largest number of parasites are destroyed.

Further investigation in this line will show whether this supposition is justified or not. It should then be carefully investigated whether (with the aid of the regular control of the eosinophilia) the dogmatic dose of 200 c.c. (according to Christopherson 30 gr.) can be replaced by an individually varying minimum that may be smaller or larger, but which at any rate guarantees an absolute cure.

The relapses so often mentioned in the literature and arising after the application of the official dose will then soon belong to the past.

When the aforementioned precautions are considered, we possess in tartar emetic a remedy that can be applied without fear, in a sufficient dose that, in conformity with the statements in the relative literature from other countries, cures bilharzia parasitism and ends the sufferings caused by bilharziasis.

The eventual anatomical lesions of the organs and tissues could then later on be treated, often with success, therapeutically or surgically.

It is therefore of primary importance that the carrier of bilharzia shall not delay or avoid the treatment until he becomes a serious bilharzia patient. The same may be said of a large number of filariasis patients, frequently met with in this country. The bilharzia—like the filaria carrier—can always be cured. The bilharzia—like the filaria patient—often not.

It is therefore necessary that tartar emetic injections should be as popular in the tropics as are neosalvarsan injections. The time should come when the Creole, Hindoo and Javanese will ask for tartar emetic injection as he now asks for neosalvarsan.

But to attain that end great circumspection is recommended in treatment, especially with tartar emetic, the results of which are less perceptible and striking than in the case of neosalvarsan.

It is preferable to apply one injection less and have a satisfied patient than to have a discontented lamenter with the full dose. It is better not to inject an infant than to cause cellulitis which will be demonstrated at home to friends and acquaintances.

It is desirable not to treat a bilharzia patient suffering from ankylostomiasis at once, but to cure his anæmia first.

The tartar emetic injection, when applied with the necessary discernment and tactfulness, will in the long run enjoy the popularity indispensable in combating diseases of the people such as bilharziasis and filariasis.

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The Treatment of Leprosy with Derivatives of Chaulmoogra Oil (H. E. Hasseltine, *U.S. Public Health Bulletin*, July, 1924).—Treatment of leprosy with the ethyl esters of the fatty acids of chaulmoogra oil as the main therapeutic agent, extending over a period of slightly over two years, has resulted in the parolling of 23 per cent. of all cases as no longer a menace to the public. Two of those parolled have relapsed. Sixty per cent. of those remaining in segregation have been definitely improved, 31 per cent. remain practically stationary after a slight initial improvement, and 8 per cent. have grown worse. Of the patients under treatment six months or longer, 69 per cent. of the incipient, 37 per cent. of the moderately advanced, and 9 per cent. of the advanced cases have been parolled. Of those remaining in segregation (under treatment six months or longer), 91 per cent. of incipient cases, 82 per cent. of moderately advanced cases, and 39 per cent. of the advanced cases have improved. The percentage of deaths in the three stages has been 0·0, 1·5 and 14 respectively.

The use of the mixed ethyl esters of the fatty acids of chaulmoogra oil intramuscularly has given better results than the esters of single acids. The addition of iodine to the mixed esters is of value in that it reduced local irritation and discomfort. In the author's experience the butyl esters have no advantage over the ethyl esters of the fatty acids of chaulmoogra oil. The ethyl esters may be used intravenously, but it is believed that the intramuscular injection is more efficient. The greatest advantage of the ethyl esters of the fatty acids of chaulmoogra oil over the crude oil and emulsion thereof for injection purposes, lies in the fact that the pain and reaction following the esters is so much less that practically all patients will take injections regularly over long periods of time. With crude oil preparations, only a small percentage of patients will continue injections a sufficient time to receive any benefit therefrom. The mixed ethyl esters of the fatty acids of chaulmoogra oil containing 1 per cent. of iodine have proven the best therapeutic agent in leprosy that has been used at the station at Kalihi, Honolulu, Hawaii, up to the present time.

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THE MOSQUITOES OF EGYPT.

EXCEPT for a few isolated records by early collectors the first systematic account of mosquitoes captured in Egypt appears to be that of Becker who collected Diptera generally in Egypt in 1902. He recorded only five species of Culicidæ, of which three were described as new. From time to time Willcocks collected a considerable number of mosquitoes, many of which were sent to Theobald for determination of the species. Gough in 1914 records seventeen species of Culicidæ from Egypt, of which twelve (possibly thirteen) were regarded as being genuine Egyptian species. A certain number of mosquitoes were also collected during the War by officers of the R.A.M.C., Lieutenant P. J. Barrand, Entomologist to the E.E.F. publishing a short "Guide to the Identification of Anophelene Mosquitoes of Syria, Palestine and Egypt," most of the information on Egyptian mosquitoes having been supplied by Mr. G. Storey of the Entomological Section of the Egyptian Ministry of Agriculture. In 1918 Mr. Storey commenced a survey of Egyptian mosquitoes which unfortunately was never completed owing to pressure of other work. Eighteen species were recorded by him, including sixteen genuinely Egyptian species, of which three had not previously been recorded from Egypt. The death of Mr. Storey in 1922 is much to be regretted as a large number of his records of the localities and breeding places of mosquitoes which would undoubtedly have been of the greatest interest and value appear to have been lost. A Blue-book[1] containing a report by the Senior Entomologist to the Egyptian Ministry of Agriculture now appears as the outcome of a request by the Anti-Malaria Commission of Egypt that the Entomological Section of the Ministry of Agriculture would undertake a Survey of the Mosquitoes of Egypt. This survey was commenced in January, 1924. Every effort has been made to make the survey of the Delta, the Fayum and the Nile Valley as complete as possible, but with the limited time it has not been possible to study the desert regions with the same detail.

Twenty-two species of mosquitoes have been recorded as found in Egypt up to the present date, and these are grouped according to the present volume as follows:—

Mediterranean species, comprising *Anopheles superpictus, Uranotænia unguiculata, Theobaldia longeareolata, Culex tipuliformis, C. laticinctus* and *C. perexiguus.*

European species, comprising *Ædes caspius* and *A. detritus.*

North African Desert species, comprising *Anopheles sergenti, A. multicolor, Culex pusillus, C. pluvialis, C. deserticola* and *C. sinaiticus.*

Almost cosmopolitan species, comprising *Culex pipiens* (originally from the Palæarctic region) and *Ædes argenteus* (originally from the West Indies?).

Spread from Ethiopian region—*Anopheles mauritianus, A. pharoensis, A. rhodesiensis, Culex quasigelidus* and *C. laurenti.*

Spread from Oriental region—*Culex tritæniorhynchus.*

It does not appear easy to state authoritatively which parts of Egypt are most infected by mosquitoes

[1] "The Mosquitoes of Egypt." By T. W. Kirkpatrick, B.A., F.E.S., Senior Entomologist Minister of Agriculture, Egypt. Government Press, Cairo. 1925. Price P.T. 30.

at the present time. The Canal Zone, more especially the western shores of the Bitter Lakes, would undoubtedly have been given the premier position a few years ago. The remarkably successful work of the Suez Canal Company, however, between 1901 and 1903, completely stamped out all mosquitoes, and consequently all malaria, from Ismailia. Results, too, are already apparent from the drainage works now being carried out by the Egyptian Government, both at Qantara and places south of Ismailia. The Nile Valley, south of Cairo, can boast of a much smaller mosquito fauna, both as regards species and numbers, than of any other part of the watered area of Egypt. This is stated to be probably largely due to the system of irrigation, as the flooding of the basin lands in the autumn clears out a large number of breeding places. When the floods subside, however, many suitable breeding places are left, but many of these now contain fish, and the numbers of mosquitoes have been much reduced by the check in their breeding at a season of the year when otherwise it would have been proceeding rapidly.

The oases of the Western Desert now appear to be the most mosquito-ridden parts of Egypt, notwithstanding the drainage operations which have greatly reduced their numbers. A notable exception, however, is the immediate neighbourhood of Siwa Town, which has become practically free from mosquitoes since the introduction of fish into all the wells, ponds and drains. The small oases of the Eastern Desert and Sinai Peninsula, such as that of Ain Gedeirat, are also much mosquito-ridden. Next in order comes the Fayum, followed closely by the Canal Zone (except Ismailia) and the Wadi Tumilat. Next must be placed parts of the Delta in the neighbourhood of large salt marshes, where large uncultivated areas exist. Considerably better off are the intensively cultivated parts of the Delta, and finally the Valley of the Nile. In the towns of Ismailia and Siwa there is less likelihood of being bitten by a mosquito than in the desert.

With regard to seasonal prevalence, all those mosquitoes which are intrusions from the Ethiopian region are hot-weather species, and the true desert species probably æstivate as adults, unless, like the *Anopheles multicolor* and the *Culex pusillus*, they have become adapted to live in cultivated areas where there are suitable breeding-places throughout the year, in which case they are most abundant in late summer and autumn. Two of the Mediterranean species, *Culex tipuliformis* and *Theobaldia longeareolata*, are definitely cold weather breeders. There are also indications that *Uranotænia unguiculata* has two minimum periods of abundance, following shortly after the very cold and the very hot weather respectively, whilst the two species of *Ædes*, which have spread from Europe, are here near the southern limit of their range, and are more abundant in cool weather.

The borrow pits and the innumerable other pools and ponds which exist in all parts of the country provide the breeding grounds for the great majority of the Egyptian mosquitoes. In many parts of the country there are numerous old sakia pits and disused shallow wells. The former seldom or never breed *Anopheles*, though they provide an abundant supply of other mosquitoes, but old surface wells are often teeming with the larvæ of *Anopheles multicolor*.

It would not appear that mosquitoes are necessarily concomitant with agriculture in Egypt, except in the sparsely cultivated low-lying salt lands, where there are often pools of water during the whole year and numerous uncared-for stagnant drains, and in the case of rice cultivation. In the former efficient drainage would both enable mosquitoes to be controlled, and would bring under cultivation large tracts at present lying waste. The advisability of rice cultivation depends largely on the part played by *Anopheles pharoensis* in the spread of malaria, and it would be of little value to prohibit or restrict rice cultivation until attempts had been made to deal with all the other possible breeding places of this species in the neighbourhood. *Anopheles multicolor*, however, said to be the chief carrier of malaria, does not breed in rice fields. *Anopheles sergenti*, which carries malignant tertian malaria, breeds in the rice fields in the Western Oases and on the shore of the Bitter Lakes; it has not, however, yet been found in the rice fields of the Delta, and probably does not occur there.

F. E. T.

Annotations.

The Larval Trematode Infestation of the Fresh-water Molluscs of San Juan Island, Puget Sound (H. M. Miller, jr., *Washington University Studies*. Vol. XIII., No. 1, 1925).—A survey has been made of the larval trematodes infesting the fresh-water molluscs of San Juan Island, Puget Sound. In so far as the search for molluscs was thorough, each of the five habitats examined has a characteristic fauna, and a correspondingly characteristic larval trematode fauna, *Lymnæ stagnalis*, and three, and possibly more, species of small *Planorbis* yielded the greatest number and variety of trematodes.

About half of the larvæ found are furcocercous; seven species are new and two were found previously in Michigan. Because of the isolated position of the island, the few fresh-water habitats, and the limited vertebrate fauna, it is thought that San Juan Island offers particularly favourable conditions for the study of trematode life histories. This survey of the larvæ has been made as a basis for such investigations.

A Case of Pulmonary Moniliasis (A. Collard and D. Jaumain, *Bruxelles-Médical*, October 18, 1925). In this communication Collard and Jaumain record the first case of broncho-pulmonary moniliasis contracted in the Belgian Congo. It presented the characters or course of a case of pulmonary tuberculosis. Examination of the sputum, including in-

jection of a guinea-pig, proved negative for tubercle bacilli. Radioscopic examination also gave an image different from that of pulmonary tuberculosis. The apices and margins of the lungs were clear, but the central portions of the lung parenchyma showed a dense opacity with cavity formation. Bucco-laryngeal complications were present, giving the appearances of laryngeal tuberculosis. Treatment, including injections of oil of picot (iodoform, eucalyptus and creosote), intravenous injections of cacodylate of soda and the simultaneous oral administration of iodide of potassium, was inefficacious and the case terminated fatally. A monilia was obtained on culture which was pathogenic for the rabbit when injected intravenously or into the lungs, but was entirely without effect on subcutaneous or intraperitoneal injection. Further researches into the characters of the monilia are made the subject of a further communication to the Belgian Society of Biology.

Rocky Mountain Spotted Fever. Experimental Study on Tick Virus (R. R. Spencer and R. R. Parker, *Public Health Reports*, November 28, 1924).—In confirmation of earlier observations of previous workers, ticks of the species *D. andersoni* which have received the infection of Rocky Mountain spotted fever in the larval or nymphal stage retain it in the adult stage. A twenty-four hour incubation at 37° C. of unfed hybernating nymphs and adults infected as larvæ and subsequent injection of such ticks into guinea-pigs give a higher percentage of positive infection than the injection of similar ticks not incubated.

Infection of Rocky Mountain spotted fever in adult ticks subjected to winter temperatures (32° F. or below) may be demonstrated by the production of immunity in guinea-pigs following the injection of tick viscera immediately upon removal from cold temperatures, by a moderate but typical spotted fever following the injection of ticks after twenty-four hours incubation at 37° C., and by virulent spotted fever following tick feeding or the injection of ticks after feeding. Control adult ticks free from all infection do not produce death or illness in guinea-pigs by feeding nor by injection of such ticks after feeding. One infected adult tick may contain after feeding from 3,000 to 5,000 M.I.D. for a guinea-pig. Emulsion of infected fed adult ticks treated with 0·5 per cent. phenol will protect guinea-pigs against 1 c.c. of blood-virus. Nothing in the behaviour of blood- or tissue-virus is comparable to the changes observed in tick virus.

A Case of Spirochætosis Bronchialis (H. L. Heimann, *The Med. Journ. S. Africa*, July, 1925).—This constitutes the second of the "four cases of interest" of Dr. Heimann's paper. A married woman, aged 28, was seen in April, 1925. She had had a "cold" three months previously and coughed ever since. The cough was spasmodic and worse in the early morning, when she expectorated a thick, yellow sputum. There had been no hæmoptysis, no night sweats and no gastro-intestinal symptoms. She was three months pregnant. At various times there had been night fever. The general condition was good, though she had lost weight in the early stages of her illness, but had regained it. The physical signs in the chest suggested the diagnosis of pulmonary tuberculosis. Previous examinations of the sputum, both directly and by concentration methods, were negative for tubercle bacilli. Another examination showed *Bacillus friedländer*, streptococci and spirochætes, but no tubercle bacilli. An early morning specimen, after careful cleansing of the mouth, showed the presence of *Spirochæta bronchialis* in numbers. The pregnancy was allowed to proceed. Treatment consisted in the oral administration of liquor arsenicalis and sodium glycerophosphate and an autogenous vaccine prepared with the secondary invaders. Then intramuscular injections of sodium cacodylate combined with sodium glycerophosphate were given. The signs and symptoms disappeared and the patient has remained free from recurrence.

Melioidosis: A Disease of Rodents Communicable to Man (A. T. Stanton and Wm. Fletcher, *Bulletin Institute for Med. Research*, Federated Malay States. No. 5, 1924).—Melioidosis and tularæmia, two diseases which cause a large amount of damage, are of very limited distribution, especially the latter. Apart from one case in Singapore, melioidosis has been recognized nowhere except in the towns of Rangoon and Kuala Lumpur. As it is difficult to believe that the disease is confined within such limited bounds, the authors have written this paper to enable other workers to recognize the disease when they meet it. Melioidosis is very like glanders, and its symptoms vary according to the part or organ of the body affected. The true nature of the disease can be determined only by cultivation of the causative organism, *Bacillus whitmori*, from the lesions, or blood, sputum or urine. The organism has very marked specific characters, which have been described in detail by Whitmore (1913). Goats, guinea-pigs, rats and other rodents are very susceptible to the disease; domestic fowls are not. The characteristic lesion of melioidosis is a small, yellow caseous nodule which commences as a collection of polynuclear cells surrounded by a zone of congestion. By the time these nodules have become large enough to be visible to the naked eye, they consist of a mass of necrotic, caseous material containing a great number of chromatin fragments which are the remains of dead nuclei. The lungs are nearly always affected. The spleen is enlarged and frequently contains nodules and small abscesses filled with thick greenish-white pus. Melioidosis presents no cardinal symptoms upon which to base a diagnosis. Some of the most acute cases resemble cholera or plague; others resemble malaria, enteric fever or general tuberculosis. With two exceptions, every person known to be infected with the disease has died; of these two exceptions one recovered after a long illness, and the other

was still an invalid with abscesses, sinuses and chronic suppuration in the bones of his feet and legs, more than two years after the commencement of the malady.

Fractionation of Chaulmoogra Oil. (II) *Evidence of the Existence of a Highly Unsaturated Optically Active Acid* (R. Wrenshall and Arthur L. Dean, *Public Health Bulletin*, July, 1924).—The high boiling portions of the mixed fatty acids derived from commercial chaulmoogra oil contain, associated with chaulmoogra acid, a liquid acid of high iodine value. By systematic fractional distillation of the liquid acid residue after the removal of chaulmoogra acid by crystallization, fractions were repeatedly obtained with iodine values of 160 or higher. By applying the lead salt-ether method to highly unsaturated fractions a material was obtained with an iodine value of 168·3 by the Hubl method with a three-hour saturation period. By following the suggestion of Lewkowitsch and allowing a longer period the iodine value rose to 180·4. By catalytic reduction with hydrogen, dihydrochaulmoogric acid was obtained from this highly unsaturated acid. It is believed that this acid is a chaulmoogric acid with a second double bond and a formula of $C_{17}H_{29}COOH$. The work herein reported has been greatly facilitated by personnel and materials furnished by the Territorial Board of Health, Territory of Hawaii, and a generous donation which was used to procure special apparatus and other necessities for the advancement of the investigation.

The Treatment of Leprosy with Compounds of Antimony (H. E. Hasseltine and P. J. Gorman, *Public Health Bulletin*, July, 1924).—A trial of colloidal antimony in a group of ten lepers resulted in a very slight gain of strength of the hand-grip in anæsthetic cases, when tested by the dynamometer. However, a control group, not receiving antimony, showed almost as great improvement in this respect. No effect upon the lesions of nodular and mixed cases nor upon the number of acid-fast bacilli in the lesions was observed. From the limited experience gained from the observation of a small group, the authors feel that antimony compounds should not be used to the exclusion of chaulmoogra derivatives in the treatment of leprosy.

The Formol-Gel Reaction in Leprosy (H. E. Hasseltine, *Public Health Bulletin*, July, 1924).—The formol-gel test has been applied to serums of 195 cases of leprosy and the same test, incubated at 37° C., was applied to the serum of 170 of these cases. The test was read at the end of twenty-four, forty-eight and seventy-two hours. At room temperature, of 195 serums tested, 118, 137 and 154 showed positive results at the end of twenty-four, forty-eight and seventy-two hours respectively. At 37° C., of 170 serums tested, 126, 154 and 161 showed positive results at the end of twenty-four, forty-eight and seventy-two hours respectively. The test was applied in 49 cases of anæsthetic leprosy, 91 cases of nodular leprosy, and 55 cases of mixed leprosy. At the end of twenty-four hours the anæsthetic cases gave positive results in 45 per cent., the nodular cases in 64 per cent., and the mixed cases in 69 per cent. Correlation of the results of the formol-gel and Wassermann tests shows that they have a tendency to agree, especially in those giving highly positive Wassermann reactions. On the other hand, at least 50 per cent. that gave a negative Wassermann reaction, gave a positive formol-gel reaction. The application of the test to 14 supposedly normal persons, all of whom, with one exception, showed no evidence of a positive Wassermann reaction, gave a negative result when the test was set at room temperature. When set at 37° C. 3 out of 14 showed a weak positive formol-gel test at the end of twenty-four hours, and at the end of seventy-two hours 10 of the 14 showed some degree of positive result. A greater proportion of positive formol-gel reactions are found in advanced cases of leprosy than in incipient or moderately advanced cases. The formol-gel reaction cannot be considered a reliable serum reaction for the diagnosis of leprosy, but may have some value as a corroborative test.

The Wassermann Reaction, Kolmer's New Complement-fixation Test, and the Kahn Precipitation Test in Leprosy (H. E. Hasseltine, *U.S. Public Health Bulletin*, July, 1924).—There apparently is a tendency to the formation of some reagin in the serum of lepers that will fix complement in the presence of the usual Wassermann antigens, particularly with cholesterinated alcoholic extracts. This tendency shows least when acetone insoluble lipoid antigen is used. It is most noticeable in the nodular type of leprosy and least observed in the anæsthetic type; and in all types it is seen more frequently in the advanced cases. The antigen devised by Kolmer, and used in his new complement-fixation test, gives satisfactory results, and it is believed that the Kolmer test is the preferable procedure in determining syphilis in lepers. Although work with the Kahn precipitation test has not been entirely satisfactory thus far, it is believed that this test will prove a valuable one in determining the presence of syphilis in leprous subjects.

The clinical diagnosis of syphilis in leprous subjects in Hawaii is extremely difficult. In some cases syphilis seems very effectively masked by leprosy. The Wassermann reaction cannot be considered an aid in the diagnosis of leprosy. A large number of undoubted lepers give a negative W.R. even when highly sensitive cholesterinated antigen is used. In the differential diagnosis of leprosy and syphilis in doubtful cases a positive W.R. with acetone insoluble lipoid, or the Kolmer, antigen is strong presumptive evidence of syphilis, and in the absence of definite evidence of leprosy such patient should be given antisyphilitic treatment before he is declared a leper. Lepers who give a positive

blood W.R. have a graver prognosis than those giving negative W.R. A positive W.R. against an acetone insoluble lipoid antigen, or against the Kolmer antigen, is ample evidence to justify the rigorous use in leprous subjects, of antisyphilitic measures, and such measures should be checked by serum tests during and after such treatment.

Bilharziasis of the Female Genital Tract (R. W. B. Gibson, *Medical Journal of South Africa*, September, 1925).—It was formerly believed that bilharziasis was much commoner in men than in women, but recent work has shown that the difference is not due to sex, but to other circumstances. The researches of Mrs. Ellgood in Egypt, of Turner in Johannesburg, and of Howard in Nyasaland have established the fact that women are more commonly infected than was formerly believed; and Gibson, in recording a case of bilharzial affection of the Fallopian tube complicating a tubal pregnancy, states that it is probable that incidence of genital bilharziasis in the female is much commoner than the published reports of cases would suggest. The more superficial parts of the genital tract in women appear to be most commonly affected. At the vulva papillary growths or deep ulceration results. The papillary growths often assume considerable proportions and closely resemble venereal warts in appearance. The ulceration may cause destruction of the hymen and clitoris and may completely surround the urethral orifice. Papillary growths at the edges of the ulcers may simulate carcinoma. In the vagina the mucosa and submucosa are thickened with friable tissue which is easily eroded, with resulting hæmorrhage and even vesico-vaginal fistulæ. In the cervix the disease takes the form of polypoid excrescences or small fibro-adenomatous tumours, and closely resembles carcinoma. Bilharzial disease of the body of the uterus does not appear to have been recorded up to the present.

The uterine appendages would appear to be rarely affected. Sumners, in Egypt, recorded such a case in a young child in whom a mass of tissue was found involving the ovary and upper edge of the broad ligament, on which *Bilharzia* ova were found on microscopic examination. Gibson now records a case of bilharzial affection of the Fallopian tube complicating tubal pregnancy in a married woman aged 25, who, four months after marriage, consulted her doctor in Johannesburg because she had missed one menstrual period. The early part of her life had been spent in Durban, and there had never at any time been any of the usual symptoms of *Bilharzia* infection. She presented the signs and symptoms of extra-uterine pregnancy, and this diagnosis was confirmed at operation. The ovum occupied the ampulla of the unruptured tube, and there had been a fair amount of bleeding into the peritoneal cavity through the abdominal striæ. The distal part of the tube was greatly thickened and the mesosalpinx was filled with irregular masses of soft fibrous tissue. The tube and broad ligament were removed, and on microscopic examination showed the presence of terminal-spined *Bilharzia* (*Schistosoma hæmatobium*) ova in great numbers. It would appear probable that in this case the bilharzial lesion was responsible for the arrest of the fertilized ovum and the development of the tubal pregnancy.

Tryparsamide in Syphilis (Wm. C. Menninger, *Medical Journal and Record*, September 16, 1925).—Tryparsamide, an arsenical compound containing 25·32 per cent. arsenic in the pentavalent form, has shown itself to be an effective therapeutic agent in cases of trypanosomiasis. Its use in the treatment of syphilis is based more upon its power to penetrate nervous tissue, rather than its spirochæticidal power. From clinical studies, it is found advantageous in the treatment of neurosyphilis, particularly general paralysis, but is ineffective in primary and secondary syphilis, and in tertiary syphilis in which there is no involvement of the central nervous system. The method of treatment usually advised is in either two- or three-gramme doses, dissolved in 10 c.c. of sterile water, given intravenously once a week for a course of eight to twelve doses. A rest period of one to three months is given between courses. One or more courses may be given. The only serious disadvantage is encountered in visual disturbances, which occur relatively infrequently, and need not cause permanent damage if careful attention is given to the dose of the drug.

Correlation of the Sulphite Reduction Test with other Tests in the Bacteriological Examination of Water (W. J. Wilson and E. M. McV. Blair *Journal of Hygiene*, October, 1925).—The results of these investigations are: When 40 c.c. of water samples are added to an equal volume of a glucose-sulphite-iron-agar medium, the number of dark sulphide colonies varies from 0 to several hundreds, according to the degree of contamination of the water. (*a*) Very pure water, whether surface or well, shows none. (*b*) A potable water should not show more than 4. (*c*) Sand-filtered water should not show more than 1.

There is a fairly close agreement in the results of the *B.coli* and the reduction tests. Where *B. coli* is found in small amounts of water, of which 40 c.c. contain no reducers, it has been found that the coliform bacilli are not true *B. coli*, but that they are allied to *B. aerogenes*, as shown by Koser's citrate test. The dark colonies can be classified according to their size into large, medium, small and tiny. *B. welchii* usually forms a large or medium colony. A selective medium for streptococci is described. The sulphite medium can be applied in attempts to isolate typhoid bacilli from water or stools, the addition of brilliant green in 1 in 1,000 to 1 in 20,000 inhibiting the growth of anaerobes whilst allowing that of *B. typhosus* in the sulphite medium. The results obtained in the examination of 252 samples of water by the *B. coli* and sulphite reduction tests are correlated.

Current Literature.

ARCHIVES DE L'INSTITUT PASTEUR DE TUNIS.
Tome XIV, No. 3, 1925.

Note on the Existence of Hymenolepis nana in Tunis (A. Espie).—During the last two years investigation has been made on the intestinal parasites of natives of Gafsa. Of 396 specimens of fæcal matter examined, twenty-eight were found to contain eggs of *Hymenolepis nana*. They never surpassed 68 to 70 microns in length. 550 specimens of natives and fifty of Europeans in the region of Sfax were also examined, with the result that the presence of eggs identical with those found at Gafsa was detected thirty times. Most of the stools examined were from children; no adult worms were found. *H. nana* has been found by several authors in North Africa, but it is believed that this is the first time its presence has been detected in Tunis. This parasite causes various disorders in the human organism: gastro-intestinal troubles, nervous symptoms, &c. Europeans complain of these troubles, but the natives do not seem to feel any effects. Although these investigations show the percentage of infestation to be high, it is thought that *H. nana* is harboured by a greater number of inhabitants of Tunis than it was possible to examine.

Experimental Immunity of the Dog in Kala-azar: Evolution of the Malady in Dogs: Natural Immunity and Immunity by the First Natural Attack (Ch. Nicolle and Ch Anderson).—The following conclusions are drawn from this paper: A first attack of experimental kala-azar, of canine or human origin, gives immunity to the dog vis-a-vis an injection strongly virulent for the dog. It is probable that a first natural attack of kala-azar also leaves such immunity, and it is also possible that consecutive immunity to either natural or experimental disease is not only of a transitory duration. There has been no proof of the existence of natural immunity to kala-azar in the dog. Different dogs, inoculated with either canine or human virus, do not present the same infections. Very often experimental kala-azar is cured after a duration of some months, during which the presence of numerous *Leishmania* can be detected in the bone-marrow or in the liver. Fatal cases occur where the animal is either severely infected or in a cachectic state after the infection is cured or on the way to being cured. To preserve virus in dogs four to six animals should be inoculated, and passage of the virus carried out on animals known to be well infected towards the second or third month of inoculation. It is believed that the evolution in the dog of natural kala-azar does not differ from experimental kala-azar.

Experimental Researches on the Mode of Transmission of Kala-azar (Ch. Nicolle and Ch. Anderson).—These experiments were carried out with the aim of proving whether the bug plays a rôle in the transmission of kala-azar. Bugs frequently feed on the blood of dogs and suffer no effects and continue reproducing. In this way they are capable of transmitting virus from dog to dog and from dog to man, but experiments prove that they do not play the rôle of agent in transmitting kala-azar.

Note on Paramelitensis (Et. Burnet).—By agglutination, confirmed by the absorption of the agglutinins, two groups of *melitensis-abortus* can be distinguished, classed as group I and II; group II corresponds to *paramelitensis*. *Paramelitensis* possesses the characters described by Bassett-Smith; it is agglutinable by the non-specific serums; it does not produce agglutinin in the rabbit, but spontaneously agglutinates in peptone water. *Paramelitensis* cannot be classed with the non-agglutinable *melitensis*. The parasite is not rare; it is partly responsible for the relapses of the agglutinant reaction in Mediterranean fever.

Three Cases of Kala-azar in the Adult in Tunisia (Et. Burnet, F. Masselot, F. Calmida and G. Ortona).—The first case reported of kala-azar in Tunis was observed by Laveran in 1904, and the second in 1906 by Nicolle and Casuto. Since 1904 to the end of 1924 sixty-seven cases have been reported, but not one of these cases was an adult. All the patients were between five months and nine years of age. Since the beginning of 1925, however, three cases of kala-azar have been observed in adults. The first of these three was reported in a woman in Paris who lived at La Goulette. The other two were observed in the hospital at Tunis. In none of these three cases has the origin of the malady been determined.

Medical News.

UNIVERSITY OF LIVERPOOL.

EXAMINATION LIST. DECEMBER, 1925.

Faculty of Medicine.

Diploma in Tropical Medicine.—A. R. D. Adams, M.B., Ch.B.; F. R. Ashton, M.B., Ch.B.; Esther Ashworth, M.B., Ch.B.; C. W. Bamford, L.R.C.P., M.R.C.S.; J. Beinashowitz, L.R.C.P. and S., L.R.F.P. and S.; G. Clark, M.B., Ch.B.; B. A. Coghlan, M.B., Ch.B.; Ivy Collier, M.B., B.S.; P. G. Cumming, L.R.C.P., M.R.C.S.; M. Fisher M.B., Ch.B.; M. S. Grutu, M.B., B.S.; A. J. Hawe, M.B., Ch.B.; Z. H. Jafri, M.B., B.S.; Elvy I. Johnstone, M.B., Ch.B.; J. R. Kerr, M.B., Ch.B.; D. M. Mackay, L.R.C.P., M.R.C.S.; M. M. el Makkawi, L.R.C.P. and S., L.R.F.P. and S.; L. G. Maldonado, M.D.; S. F. Mar, M.D.; B. P. Mozoomdar, L.M.S.; D. A. Skan, L.R.C.P., M.R.C.S.; E. R. Stone, M.B., B.C.; C. G. Terrell M.B., Ch.B.; F. Tooth, L.R.C.P., M.R.C.S.

Recommended for Milne Medals: Dr. Adams. Dr. Hawe.

Original Communication.

VIRUS DISEASES OF BACTERIA, PLANTS AND VERTEBRATES.

By H. P. Bayon.
Cambridge.

I.—Introduction.
II.—General Properties of Filtrable Viruses.
III.—Virus Diseases of Bacteria (Twort's Bacteriolysin).
IV.— ,, ,, of Plants.
V.— ,, ,, of Animals.
VI.— ,, ,, Transmissible from Animals to Mankind.
VII.—Neurotrope Viruses: (1) Poliomyelitis; (2) Herpes; (3) Epidemic Encephalitis; (4) Spinal Amyotrophy.
VIII.—Influenzal Catarrh and Filter-passers.
IX.—Specifically Human Virus Diseases; Molluscum and Warts.
X.—Diseases conveyed by Arthropods: (1) Leptospirosis; (2) Rickettsia.
XI.—Neoplasms, Parasites and Viruses.
XII.—Rous-fowl Sarcoma and similar Viruses; their Relation to Oncology.
XIII.—Specific Properties of Microplasms and their Classification.
XIV.—Conclusion.

I.—Introduction.

The study of parasitic filtrable viruses is not without importance for medical men in the tropics, for quite apart from the interest arising from universal epidemics caused by these micro-organisms, several diseases of warm climates, whose pathogenesis is still obscure and whose sudden appearance, rapid spread and gradual but equally unexpected disappearance have not got beyond the stage of conjectural explanation, may yet yield a solution of the riddle by an increased knowledge of these minutest among the minute harbingers of disease. In fact it is quite possible that tropical diseases whose ætiology and pathology appear to be a concluded chapter and a finally settled question, may be discovered to originate in the first instance through the action of a "virus."

In this as in many other epidemiological matters we have to refer to L. W. Sambon as a torchbearer, for I remember that about fifteen years ago in one of his lectures at the School of Tropical Medicine at the Albert Docks, in explaining the well-known lack of cyclical development of the parasite of malaria in the anopheles of certain regions in Italy, he suggested it might well be due to the presence of a minute germ, a "hypo-parasite" as he called it, preying on the plasmodium. At the time this appeared a bright idea and nothing more, but the discovery by F. W. Twort in 1915 of the lysin-body invading and dissolving *B. coli* has brought this suggestion of Sambon well within the range of concrete realization.

It may be recalled that L. W. Sambon has published two epidemiological studies of cancer in this Journal, one on June 2, 1924, the other February 2, 1925, in which he definitely states that cancerous growths developing as a result of helminthic infestation are very probably due to ultramicroscopical viruses; and accordingly it has been objected that ignorance of the causation of cancer is being obscured by the exorcism of powers we know as little about. This is not so, as the following pages will attempt to prove.

In the main this paper was begun at Robben Island, in 1913, at the instigation of Sir Patrick Manson, who at that time was visiting South Africa. Interrupted by other work it was taken up again in 1917, following numerous filtration experiments performed at the Middlesex War Hospital at Napsbury, again abandoned and eventually completed in the present form during 1925.

II.—General Properties of Filtrable Viruses.

True filter-passing viruses differ in many important properties from pathogenic protozoa and bacteria, though admittedly superficial resemblances to the former or latter can at times be detected; the resemblances, however, not being of sufficient importance to warrant the inclusion of parasitic filter-passing viruses in an intermediate phylum like that of the Protista; it should however be noted that certain spirochætal bodies (*Leptospira*) are apt at times to behave like microplasms.

They are invisible or ultramicroscopic—but the two terms are by no means interchangeable. They are to a certain point invisible with ordinary microscopic methods, but in many cases this invisibility requires qualification, as in filtrates from virus-infected material one can often detect numerous very minute granules by means of a good dark-ground illuminator. Some of these are possibly small agglomerations of virus, but they cannot be differentiated with certainty from other similar pulviscular bodies which are accidental and incidental contaminations of every filtered fluid. Therefore it would be more correct to call them morphologically indistinguishable or unrecognizable.

In time, by means of photomicrography with short-waved ultra-violet rays, dark-ground illumination, and other means, we shall be able to ascertain more about the morphology of invisible viruses, but in this matter at the present moment we are in the analogous position of investigators about fifty years ago who were studying "zymotic" diseases. They found undeniable bacteria everywhere, and in everything, and did not possess our methods of artificial culture or knowledge of agglutination and immunity, enabling them to differentiate a relatively harmless saprophyte like *B. coli*, or a simple dermophytic streptococcus from a dysentery or typhoid bacillus, or again from a virulent hæmolytic coccus.

Thus invisible or ultramicroscopic does not really characterize the class—not only because in certain stages the viruses of rabies, small-pox, vaccinia, trachoma, verrucæ, &c., are clearly visible as chlamydozoic bodies, but in addition because definite filter-passers such as the virus of pleuro-pneumonia are just within the range of microscopic visibility, whilst others again, though visible, are not clearly recognizable.

Filtrable or filter-passing denotes of course a property which is also a function of size in certain stages—in other words, means that the germs constituting the virus are smaller than certain bacteria,

but not smaller than all bacteria. Filtrability is shared with many spirochætal bodies and possibly certain stages of pathogenic protozoa ; and as filtration is in reality a technical short cut to enable us to separate bacteria from certain liquids, or obtain cell-free fluids, it does not select or sift virus bodies from other corpuscles of the same or smaller size which may be or may not be of a bacterial or even protozoal nature. Under the circumstances this criterion is not applicable for the purposes of classification or nomenclature.

Other properties equally important have been observed and studied, among which may be mentioned the peculiar and distinctive affinity or predilection of certain filter-passers for the cells of one tissue and practically that tissue only. Some protozoa (*Toxoplasma, Coccidia*) show this tendency, but not to such a marked extent in every case—and bacteria can be said on the whole to be fairly universal in their choice of sites for multiplication, but preferring an extracellular situation and thriving in fluids. It is true that variations within certain limits are discernible in filter-passers ; but considering the phylum as a whole one finds rabies showing a predilection for the central nervous system, though also present in salivary glands ; vaccinia for the epidermis, though the pustules appear to originate by a lesion of the capillary endothelium, and a localization in the nervous system is not unknown ; foot-and-mouth disease for the mucous lining of mouth and eyes, though evidently attacking the subunguial teguments of the hoofs ; trachoma, the conjunctivæ, inner surface of the eyelid, but a very similar virus is capable of multiplying in the urethra, and so forth.

This predilection is not an artificial distinction, such as might result by considering the gonococcus to have a specific attraction for the cells of the urethra, but is experimentally and microscopically recognizable by numerous observations which show, to take the oldest example known, that one gets the highest percentage of successful inoculations with rabies by intradural injections into the brain substance—if perhaps the practice of vaccination does not give a much older and better known confirmation of the general rule.

The production of chlamydozoic or strongyloplastic bodies in the tissues invaded is also a fairly constant appearance, which has given rise to much controversy. It is true that by various toxic and irritative influences one can bring about the production of very good imitations of Negri's or Guarnieri's bodies ; but to make use of a clinical similitude, the development of miners' phthisis through silica dust does not invalidate the claims of the tubercle bacillus as the cause of consumption of the lungs, and in the same fashion artefacts resembling the bodies found in many filter-passing diseases do not detract from the diagnostic value of Negri's bodies or the scientific interest of similar corpuscles found in many virus diseases of man and animals.

How do viruses generally bring about pathological appearances and symptoms ? It is well known that bacteria may do harm by massive multiplication (plague, lepra, anthrax), or elaboration of toxins (tetanus, tubercle), whilst protozoa more usually damage by abstracting cellular essential eleme (example : malaria), or inducing irritative changes capillaries of the brain (trypanosomes in sleep sickness), or again inducing the multiplication of cells they have settled in (kala-azar).

Viruses appear to injure by extensive intracellu multiplication—thus abstracting essential metab products from the nucleus and protoplasm and a causing necrosis by pressure. This is the explanat of the peculiar frothy, vacuolated or cytolyzed appe ance of epithelial cells in some skin conditions of m and animals—and also that of bacteria invaded Twort's bacteriolysin.

A toxic action of filter-passers no doubt exists, b is difficult to prove conclusively, as separation filtration or centrifugalization is not an easy matte

Adsorption or surface attraction phenomena pla great part in the bionomics of viruses—they complic in a disturbing fashion all filtration experiments w kaolin or porcelain filters ; in addition it explains h contrary to what occurs in bacteria in a generali infection the blood corpuscles appear to contain virus and not the serum ; the erythrocytes a leucocytes can then usually be washed free of virus

In conclusion one can surmise that they repres an ubiquitous, extremely simple form of living mat or protoplasm. It is true that, notwithstandi insistent search by Twort and others spreading o many years, it has not been possible to obtain a evidence of saprophytic or free-living viruses ; b since the principal method of detecting their prese consists in recognizing their pathogenic properties plants or animals (and we may also include bacte it is easy to explain the negative results of the sear It is of course understood that ordinary filter-passi bacteria are fairly common in various situation minute short spirilla which easily pass a Berkefeld a at times present in the fæces of guinea-pigs ; a fr living leptospira which is also filter-passing has be observed by Hindle (1925), and a very minu anaerobe by Holman and Krock (1925), in additi to Borrel's *Micromonas mesnili*, which is consider to be a filtrable protozoon.

A saprophytic filter-passer would be, however, n only extremely minute, but might make its presence absence recognizable by some enzyme-like action whi would be active after multiplying in infinitesim dilutions of a suitable medium ; and indeed Twor lysin approaches these conditions to a remarkal extent.

It is no idle hypothesis to surmise that viruses a not only extremely minute particles of protoplas with the simplest imaginable structure compatib with life—that is the faculty of selective assimilatio secretion and with the power of successive, almo limitless multiplication—but that also they ha hardly differentiated into cellular components, nucle and ectoplasm, and therefore they are extreme delicate and subject to damage by outside influenc when isolated ; the chlamydozoic mantle or shell bei accordingly a necessary protective covering suppli by the nucleus of the cell-host, for we do know th when included in cells they are fairly resistant.

The undifferentiated protoplasm explains the

ited assimilative powers, of which their selective tracellular position is but an expression, and also e need of abstracting nutrient materials which are eady suitably prepared for protoplasmic assimilation. the circumstances it is quite possible that prophytic or free-living microplasms cannot exist art from a suitable supply of ready digested and aborated albuminous substance, such as usually is ly found within a living cell.

A simple protoplasmic aggregate of molecules would so possess the quality of binding or incorporating elf with the protoplasm of the cells more intimately an a corpuscle with an ectoplasm. As a matter fact many viruses require not only mechanical ushing of their cell-host or hydrolysis, but also aceration or digestion with trypsin before they can even partially isolated from the protoplasm which rbours them—and even then one may doubt if the ocess is complete.

When discussing the properties of microplasms it is cessary to consider a peculiarity which, though esent in an analogous but restricted fashion in cteria and to a greater extent in certain protozoa, es not exactly correspond in all particulars. This is e fashion in which a microplasm will remain mpletely in abeyance, innocuous for prolonged eriods during which it gives rise to no symptoms, nd then suddenly, usually as the result of irritative timulus, produces definite recognizable pathological lterations. The expression "latency" covers the eriod of innocuous permanence, a condition well known in gonorrhœal infections, and also malarial diseases, but in these instances one is the result of minute anatomical conditions, the other the outcome f encysting. But a more accurate comparison would e given by the conditions arising in cerebro-spinal eningitis, where the micro-organism causing the isease is found as a harmless denizen of many aso-pharyngeal cavities, and so neither buried or capsulated.

In conclusion, for the reasons enumerated above one ntures to suggest the name Microplasm for the rms commonly known as invisible filter-passing ruses, a phrase which is a standing contradiction of st in every one of its terms.

One can state that it is only a simple question of me, craft and skill which will enable us in the ture to classify microplasms according to their orphology—and bionomics—in common with other rms of life, but for the present we perforce must do on the unsatisfactory basis of properties which ve so far been observed and that, possibly, but ompletely.

III.—Virus Diseases of Bacteria (Twort's Bacteriolysin).

In correct chronological sequence Twort's bacteriolysin would be placed among the viruses discovered in the second decade of this century; but as it presents numerous points of interest, is comparatively easily investigated, and has indeed been most extensively studied, it will be considered first, especially as it attacks in a specific and selective fashion cellular elements which are placed low in the scale of animate Nature. In addition the laws governing the action of the lysin and reaction of the bacterium are comparatively simple, and lead to an understanding of the more complicated problems resulting from the intricate processes involved in "virus" diseases of plants and vertebrates.

It is true that the "virus" or particulate nature of the bacteriolysin is fiercely contested by Bordet, Gratia, Ciuca, Rhode and many other Continental and British investigators, who consider the lysin to be an enzyme produced by the bacteria; but this can be said without excessive bias, that if Twort's bacteriolysin is an enzyme, not only it belongs to a new class of its own, but in addition behaves in a fashion indistinguishable from that of a virus akin to that of mosaic disease, but instead specific for certain bacteria.

An enzyme which is capable of multiplying *ad infinitum* given a suitable medium—certain living bacterial cells—is surely a curiosity of the first order, and therefore the subject will be again discussed later on in this chapter.

In the *Lancet* of December 4, 1915, pp. 1241-3, F. W. Twort published the discovery of his filter-passing bacterial lysin, though the work leading up to it had lasted over two years. The original paper gives in clear and unmistakable language the first complete account of an important discovery which has since been most extensively investigated without appreciably adding to the essential facts first described.

F. W. Twort found that by filtration through finest porcelain filters (Doulton White) he could separate from certain young cultures of micrococci, originally isolated from vaccinia lymph, a peculiar virus or enzyme which not only totally inhibited the growth of this micrococcus on agar but attacked young cultures of this bacterium and dissolved them into minute granules which stained a reddish hue with Giemsa.

A similar substance was obtained by filtration from other bacteria of the typhoid-coli group, and it was then found that the virus:—

(1) Was strictly specific for certain definite groups of bacteria from which it originally had been isolated and could not be cultivated apart from them; that is, a staphylococcus bacteriolysin had no action on streptococci, *B. coli*, yeasts, tubercle bacilli, &c., nor would multiply on their cultures.

(2) The virus could not thrive on dead bacteria, or in any known artificial culture medium if free from suitable living bacteria.

(3) Heat above 60° C. for an hour destroyed it, though it would retain its activity when emulsified and heated to 52° C.

(4) It could be kept for six months or even longer in an active state *in vitro* and would then again attack its specific bacterium.

(5) Not all strains or even individuals of the same bacterium were accompanied by this peculiar virus, for by plating one could obtain bacterial streaks which showed no signs of dissolution. Other colonies on the same plate might perhaps show a few isolated clear

spots. The virus could then only be obtained from spots which showed bacteriolysis.

(6) Occasionally the lysin appeared to arise spontaneously in pure stock cultures.

(7) It could be propagated through very great dilutions (one to millions) if incubated on agar with its accompanying bacterium, and could then be indefinitely transmitted from culture to culture of this bacterium.

(8) Laboratory animals inoculated with the filtrate in various fashions did not develop any pathological symptoms, nor was the substance recoverable from their body fluids.

F. W. Twort later discovered that specific antibodies could be produced in animals by the injection of the filtrate, but even now (1925), does not consider that the possibility of its being an ultramicroscopic germ is proved, though he admits it might almost be considered as an acute infectious disease of micrococci and thus be a virus.

Later researches by others can only be considered in the light of confirmation, amplification or completion of these fundamental experiments, for previous observations on the bactericidal properties of river water, &c., belong to a different order of ideas altogether.

Numerous investigations of the same subject were begun in 1917 by d'Herelle and his collaborators and also by different experimenters, and it was then found that the bacterial lysin could remain latent in bacteria for a few generations and then make its reappearance; that any method (antiseptics, X-rays) which was capable of killing the bacteria also inhibited the multiplication of the lysin, but if a killed culture was mixed with a living one containing lysin the dead bacteria would be attacked to a certain extent by the lysin together with the living ones (Gratia and Rhodes, 1923); that the concentration of the saline dilution employed, the addition of glycerine, higher or lower temperatures, influenced the rate at which the lysis took place, and thus numerous other factors were most patiently and exhaustively investigated; but the ultimate result can be summed up in a few words to the effect that the characters of Twort's lysin are closely analogous to those of a specific ultramicroscopic virus comparable to the one of mosaic disease in plants, and that to disprove this and prove it an enzyme a most complicated Heath-Robinson-like scaffolding of abstruse hypothesis is required.

Therapeutically applied it has not yet produced incontrovertible results. It sounds very easy to give a typhoid patient a lysin-enema or spray a diphtheria throat with a suitable lysin emulsion; but the effects in clinical medicine are so far in no wise comparable with those obtainable *in vitro*.

Immunization of animals with lysin-dissolved bacteria gives but feeble serums, but there are possibilities that the lysins may be used to deal with the "carrier" problem in typhoid and diphtheria.

The lysin bodies appear to be extremely small, slightly larger than a big albumin molecule, as repeated filtration experiments with compact porcelain candles and colloidal membranes appear to prove. It must however be understood that the smallest trace of bacteriolysin if transplanted into a suitable bacterial culture will very soon multiply in an extraordinary fashion within a few hours. Thus there is always the possibility that a minute flaw in the porous filter or membrane will allow a few bacterial fragments containing the virus to pass through, which then will give rise to Twort's phenomenon, thus inducing a wrong impression of the actual size of the germ; for apparently it can be detected under a good oil-immersion and dark-ground illumination as an extremely minute refractile granule in the body of the bacteria; in addition the eosinophil detritus left by dissolved bacteria is very suggestive. It is evident that a few hundred albumin molecules getting past a flaw in a filter would cause no appreciable difference in a filtrate, and there is no method of detecting such slight flaws or irregularities.

If, however, these objections do not hold good Twort's microplasms must be among the smallest known, though the virus of fowl-pox is capable of passing such close filters that it ought to be even smaller than an albumin molecule.

It is but fair to give the reasons which persuade many investigators to consider Twort's microplasm as a product of the bacterium. As representative one can take R. Otto and H. Munter, who consider an enzyme for the following reasons:—

(i) Because it is possible to cultivate *in vitro* a pure bacteriolysin without the need of isolating each time the corresponding bacterium from man or animal.

Answer: Otto and Munter say that a bacterial lysin can be obtained *in vitro* "wenn auch nicht regelmässig"—it really should be "ganz regelmässig," and even then it is not quite clear what the argument proves, for it is definitely known that Twort's lysin, in common with many other microplasms, can only multiply in suitable living cells. Such is the case with mosaic disease which is mechanically transferable from leaf to leaf of the same plant.

(ii) Because bacteriolysin which has been inactivated through heat when added to living cultures containing lysin will enhance and increase its power. Otto and Munter consider that it is difficult to understand how killed bacteria should favour the generation (Entstehung) of new microbes.

Answer: This observation is not without analogy in bacteriology, and has been previously experimentally confirmed with other microplasms. Much of Gye's recent work is founded on this principle. Levaditi also found that the injection of any microplasm favoured the multiplication of any pre-existing virus.

(iii) Because of the analogical observations of Ehrenberg on albuminoid enzymes, which show that enzymes can be cultivated *in vitro* through many generations.

Answer: These experiments are open to different interpretations and will have to be more solidly supported by independent confirmation before they can be accepted as valid.

For the above three reasons Otto and Munter are of the opinion that the action of the bacteriolytic substance is due to exceedingly small albuminoid particles, which originate from the bacteria themselves under certain circumstances, e.g. age, and that these

particles possess a fermentative action which is liberated by the crumbling (Zerfall) of the bacteria.

This ought to be an accurate translation of their views which are given as an example among many. The views of the writer of this paper are: Twort's lysin is particulate, visible by dark-ground illumination by which means the lysis can be followed in all its details; it can be stained as an extremely minute eosinophil granule; it has the necessary characteristics of a microplasm—rapid specific intracellular multiplication in suitable living bacterial cells; is therefore not a bacterium, spirochæte or protozoon, nor, in view of its rapid multiplication, an enzyme. Every bacteriolytic virus is specific for a certain bacterium, and accordingly there are as many distinguishable bacteriolytic viruses as bacteria subject to this peculiar disintegration.

D'Herelle himself, who holds that all bacterial lysin-bodies are but slight variations of a single virus, has experimentally proved that the affinity or specificity of a lysin-body for a certain bacterium is practically unalterable and will persist after having been propagated in a certain bacterium for years through hundreds if not thousands of transplants. He relates that in 1916 he isolated an active lysin for Shiga's bacillus, which also dissolved *B. coli*, but to a lesser degree (moyennement actif), and only very slightly, *B. typhosus* and *B. paratyphosus*. During 1917 to 1919 it was transplanted about 1,200 times in *B. shigæ*, and yet at the beginning of 1920 it had the same medium virulence for *B. coli* and feeble lytic properties for *B. typhosus* and *B. paratyphosus*.

Following this evident and clinching experience d'Herelle goes on to refer to the experiments of G. Eliava, who, having isolated a lysin from a *Staphylococcus aureus* of an abscess, propagated it over one hundred times with the staphylococcus, mixed 0·25 c.c. with 10 c.c. of Shiga bacillus emulsion, found that immediate culture on agar resulted in an ordinary streak of dysentery bacilli, but after the emulsion had remained in the incubator for twenty-four hours at 37° C. the agar plating grew to a bacterial "spread" with four blank spaces containing Shiga lysin, and successive transplants enhanced this virulence.

From this experiment d'Herelle concludes that the specific properties of lysin body can be varied at will, but in several other parts of his most interesting book, "Le Bacteriophage," several other equally convincing observations are reported contradicting this view.

As a result it is to be feared that the experiments tending to prove that a bacteriolysin can be accustomed or made virulent for all other bacteria suffers from an evident flaw known to those who have worked on the subject, and indeed observed and recognized by Twort in his first paper—that is, the "latent" property of the virus, which will remain cryptic for several generations and then suddenly appear *in vitro* and spread rapidly. And this indeed is a common character of many viruses.

It should be mentioned that d'Herelle otherwise knows that Twort's bacteriolysin is so strictly specific that he considers it could be used as a test for the identification of certain bacteria.

IV.—Virus Diseases of Plants.

Though Pasteur in 1881, whilst discussing the properties of the virus of rabies, intuitively foresaw that it might be invisible with our ordinary microscopic method and therefore filter-passing, the first definite experimental knowledge of a filter-passing micro-organism or virus was due to the study of a disease of the tobacco plant.

Iwanowsky and Polotzoff in 1892 proved that the so-called mosaic disease of the tobacco leaf was due to a germ which was so minute that it passed through a filter which held back ordinary bacteria. These results were independently confirmed in 1898 by Beijerink, who considered that mosaic disease was due to a "contagium vivum fluidum," a living, fluid contagious matter—because it was invisible to ordinary microscopic methods, passed easily through filters, and above all because it diffused through agar-plates. All these arguments are not proof positive, and an extremely minute corpuscle under the range of microscopic visibility will perform all these feats and many more. Beijerink mentions in his paper the existence of peach yellow and peach rosette, plant diseases described by Erwin Smith in 1894, and suggests they are due to filter-passers, and in this he was right, for they have been proven since to be caused by a virus.

Following these pioneer investigations many other plant diseases of a similar type have been described, in the tomato, potato, cucumber, sugar-beet, sugar-cane, maize, clover, orchid, peach, &c., some of which can be easily mechanically transferred, whilst others appear to require an intermediate insect vector, and somewhere the transmission can be only accomplished by autoplasty or graft.

Mosaic disease in tobacco and leaf-roll in the potato appear to be disseminated by green-flies (Aphidæ), though any healthy plant can be infected by dipping a needle into the diseased portion of a leaf and then scratching the leaf of a suitable plant; for it must be kept in mind that these filter-passers (in common with many others observed in animals and man) are strictly specific, that is, will only multiply and cause corresponding pathological symptoms in a certain plant and that one only.

It has indeed been observed with leaf-roll disease of potatoes that a plant of the same family on being grafted with portions of a leaf-roll diseased potato plant will develop no symptoms, but if at any later period a small piece is grafted on a healthy potato stock, it will infect them; in other words, a plant of the same family is capable of acting as a "carrier," a term and condition well known in clinical medicine.

From the standpoint of analogy with certain animal diseases it is interesting to know that the virus of mosaic disease in the tomato can be proven to be present in every part of the plant; even the hairs on the surface of the tomato leaf if snipped off and injected will cause the disease in healthy tomato

plants, but this notwithstanding the mosaic patches appear in the green leaf and there only.

These observations and many others in connection with animal disease show clearly that filter-passers cannot be studied separately and distinctly according to whether they occur as parasites of bacteria, plants, animals or man, but have to be investigated as a whole because, *mutatis mutandis*, they react towards the cells of their host, whether a vegetable or an animal, according to certain generally recognizable, definite rules.

V.—Virus Diseases of Animals.

In 1897, Löffler and Frosch proved that lymph taken from the blisters of foot-and-mouth disease of cattle, when suitably diluted with water, could be filtered and that the filtrate was still definitely infective and could reproduce the disease in cattle, and that this process could be apparently indefinitely continued until such dilutions of the original infecting dose were eventually obtained, as to render extremely improbable that the symptoms were caused by a toxin or any similar fluid. Hence they accepted the existence of extremely minute living organisms as a cause. They also concluded that :—

"Should further investigations confirm that the (pathological) results of the filtrates are due to extremely minute living organisms, as indeed all appearances suggest, then one would feel inclined to believe that the cause of many other diseases of man and animals, such as small-pox, cow-pox, scarlet fever, measles, typhus, rinderpest, which up to now have been unsuccessfully searched for, may be found to belong to this group of smallest among germs."

It can be said that these conclusions show a creditable amount of foresight!

The virus is thus filtrable, invisible with ordinary optic methods, and has so far resisted artificial cultivation.

Nocard and Roux, and Salimbeni in 1898-9 announced the filtration and subsequent artificial cultivation of the germ of peri-pneumonia or pleuro-pneumonia of cattle, a very infectious epizootic disease limited to bovines, characterized by a simultaneous inflammatory condition of the pleuræ and lungs. It is transferred by contact, the virus is not contained in the blood but only in the tissues affected. The germ retains its virulence for nearly a week in artificial cultures on agar, where it forms minute colonies of short, slender, very mobile and polymorphous rods, differing therefore in this particular from many other viruses or microplasms.

This disease and the micro-organism causing it appear to be in a class by themselves, and may prove to be a connecting link between bacterial diseases and those due to cytotrope viruses or microplasms. Borrel considers the agent of peri-pneumonia to be a bacterium and has given it the name of *Asterococcus mycoides*.

Protective inoculations with pure cultures have been successfully practised, though the serum of immunized animals shows but feeble protective properties.

Also in 1898 Sanarelli described a peculiar disease of rabbits at Montevideo, characterized by a catarrhal blepharo-conjunctivitis of the eyes followed by swelling of the nose and mouth, anus and genital regions, and sometimes the appearance of small subcutaneous, gelatinous tumours in various parts of the body. In does the nipples may become hypertrophic

It is true that definite proof of the filtrable properties of this virus was not forthcoming till 1911 when it was shown to be so by A. Moses, of Rio Janeiro, after unsuccessful attempts by A. Splendore in 1909, but, from the first, microscopic appearances were recognized to be those of a cytotrope virus-disease.

In 1900 McFadyean discovered the filtrable properties of the virus of African horse sickness, an acute febrile disease with œdema of the eyes and neck, and terminal pulmonary œdema. Its transmission in nature by a mosquito or stable-fly is suspected but experimentally ingestion of the filtered virus will produce the disease. These results were confirmed by Nocard in 1901, though a somewhat similar disease of bovines, called "barbone," is caused by a non-filtrable "pasteurella," *P. bovi-septica*.

Also in 1901, Centanni and Savonuzzi and a little later Maggiora and Valenti described a disease of blackbirds and also other birds (fowl pest) characterized by pericarditis and intense congestion of the lungs. The virus is filtrable and cannot be artificially cultivated.

In 1902 Nicolle and Adil Bey proved that the virus of cattle plague is a filter-passer.

The disease consists in a sero-purulent inflammation of the mucous membranes, rapid emaciation and bloody diarrhœa. The transmission is by contact and contamination of the food by excreta. The virus is resistant, is still infective after drying for a week or even twelve days, or can be retained on hay kept in the dark for a couple of months or more.

The germ is neither visible nor has it been cultivated.

In the same year Borrel published his results with the virus of clavelée or sheep-pox. This is an acute febrile contagious disease of sheep, consisting in a generalized eruption of papules, vesicles and pustules not very deadly, and leading to complete immunity after recovery. Transmission is by contagion.

The cytotropic virus is filtrable, very resistant to drying and retains its virulence for two years if kept in a dry place.

Marx and Sticker also in 1902 published the filtrable nature of the virus of fowl-diphtheria and fowl-pox which are different localizations of the same germ, as proven by Carnworth, Hutyra and Marek, Borrel and others. These are fairly common diseases well-known to fowl breeders for many decades. Infection is by contact or ingestion of soiled food. The type of disease varies according to localization—it more commonly consists in warty excrescences of the comb, corner of the mouth or eye, folds under the wing, vent, &c.

These epithelial proliferations may break down, yet heavily bacterially infected, coalesce and then do resemble small-pox, but equally often only sma

lumps or tumours are formed which shrink and dry up in the course of a month or so.

One noticeable property of this virus is called "dermo-tropismus" by Lipschütz, and consists in the experimental observation that if one injects a fowl intravenously with the virus no proliferations will appear except at places which have been artificially irritated by scarifying or rubbing with sand paper. This peculiarity it shares with vaccinia and to a certain extent other viruses which will "localize" or produce pathological alterations in positions which have been mechanically injured.

This virus is important from the standpoint of analogy, for it is capable of producing extensive epithelial proliferations and presenting several features which remind one of warts and thus also of epithelioma. It is true that no metastasis results and that the warts disappear spontaneously; and thus Borrel no doubt was justified in saying that the condition is analogous, but by no means identical with cancer.

The virus is extremely virulent, will act in dilutions surpassing one in 100,000, and moreover does not always give rise to epithelial proliferations, for if it happens to attack or multiply in the mucous membranes of the mouth and windpipe a membranous exudation with abundant bacterial invasion will result, the air passages may be obstructed, and death with œdema of the lungs follow. Immunity occurs after recovery.

In 1903 Roux, and soon after Borrel, reviewed the knowledge obtained by the investigation of filter-passing viruses.

Roux includes among them foot-and-mouth disease, peri-pneumonia of cattle, virus myxomatosus of the rabbit, mosaic disease of tobacco, African horse sickness, fowl-plague, yellow fever, sheep-pox and rinderpest.

Borrel's list includes foot-and-mouth disease, sheep-pox, fowl-pox, rinderpest, vaccinia and variola. To-day (1925) the list would embrace over fifty diseases of plants, animals and human beings, and may yet be considerably added to.

Two other animal diseases caused by filter-passers should be considered, owing to the peculiar symptoms they are capable of producing. One of these is infectious agalactia of sheep and goats, whose germ was proven filtrable in 1904 by Celli and Blasi; and the other, swamp fever of horses, an infectious chronic fatal anæmia of horses, the filtrable properties of the germ in the blood and urine being demonstrated by Carre and Vallée in 1904. The disease is peculiar to horses; infection is possible by injection and ingestion of the filtrate, the resulting hæmatological picture showing striking resemblance to some cases of pernicious anæmia in man. Analogous diseases in fowls are also known.

The investigations in connection with hog cholera or swine fever are specially important and interesting. For a long time this disease was considered to be a septicæmia due to a bacterium of the *coli* group—*Bacterium choleræ suum*—which could be isolated from the blood and dejections in a very great percentage of the animals affected by the disease. The serum of a great number was also found to react practically specifically with the bacterium, which as a matter of fact could be recovered from the intestine of a large proportion of healthy pigs.

This notwithstanding that de Schweinitz and Dorset (1903) proved experimentally that the disease was due to an unrecognized filter-passer, and this was further confirmed by Dorset, Bolton and McBryde in 1905. It was then found that a simple infection by the filter-passer gave the appearances of swine-fever, but where a superadded invasion of the system by the *B. choleræ suum* took place then hog cholera resulted.

Immunity is complete after recovery. Protection by injections of serum from immune hogs is very successful. Personally I have seen herds of 200 or more porkers saved by these means, in an outbreak taken in its early stages in a breeding establishment where practically the whole herd had been wiped out by a previous epizootic.

Some forms of distemper in young dogs were shown to be due to filter-passers by Carre in 1905, and Theiler and Robertson proved the same fact in the case of catarrhal fever of sheep—so-called "blue-tongue."

These animal diseases have been mentioned to show the economic importance of filter-passers and it may be said that the number is yearly being added to, by the inclusion of diseases which have long been suspected of being due to viruses and others where this ætiology had never been previously suspected.

Epitheliosis contagiosa in fowls has been previously described and its analogy with cancer alluded to, but with the discovery by Peyton Rous in 1911 of a peculiar fowl-sarcoma which was proven to be due to a filter-passing virus, originally strictly specific for Plymouth Rock, later producing neoplasms in other breeds of fowls, the study of proliferative viruses received a great impetus.

Peyton Rous further described two other neoplasms of the fowl, which could be induced by a cell-free filtrate, an osteo-chondro-sarcoma and a peculiar reticulated sarcoma. In the course of experiments it was found that when dried these sarcomatous tissues could be kept for months and then ground up, suitably emulsified and then give rise to the corresponding neoplasm. In addition he observed that intravenous injections of the virus alone did not give rise to tumours and that it was necessary to inject a small quantity of diatomaceous earth with the virus to induce proliferation in the connective tissue and help the formation of a tumour. Numerous other growths of fowls were investigated and the majority of them were found to belong to one of the three groups mentioned above.

Murphy and Rous found that chicken-sarcoma when implanted into chicken embryos was capable of producing malignant transformation in the mesodermal tissues only—a further proof of its "specific" nature.

It should be noted that spontaneous sarcomatous fowl tumours exist which cannot be transferred by a cell-free filtrate or after desiccation.

Quite lately S. Adler (1925) has described a disease

of fowls in Palestine characterized by leucocyte inclusions, which are of the chlamydozoon type. The disease resembles fowl-spirochætosis, attacks Rhode Island Reds, Leghorns and hybrids of the above varieties with native fowls, but—and this is important—native fowls are not observed to be attacked. The symptoms are fever up to 110° F., diarrhœa with greenish droppings, death within fourteen days. Liver and kidney show fatty infiltration and patches of necrosis, numerous chromatic inclusions in the protoplasm and also nucleus of leucocytes.

Native fowls (three out of twenty-five examined) were observed to show the same inclusions in leucocytes, the inclusions persisting in the blood from one to seven weeks during which time the leucocyte count rose to 34,000.

Therapeutic trials with arsenical preparations were found to be fruitless. Experiments with ticks failed to transfer the disease.

Filtration is not mentioned, but the careful observations recorded enable one even without the winged touch of Sambon's methods in epidemiology to recognize the disease as due to a "virus" though it differs from fowl-leukæmia in many particulars.

VI.—"Virus" Diseases Transmissible from Animals to Man.

So far the diseases reviewed are restricted to animals or plants, and their interest for the clinician possibly remote, but with the experimental proof brought in 1904 by Remlinger and Riffat Bey and later di Vestea that the virus of hydrophobia or rabies could pass a Berkefeld filter and remain infective, a new group of diseases was brought into purview—those common to or rather transmissible from animals to man, for the accidental human contagion with the virus of foot-and-mouth disease is not common.

The symptoms of hydrophobia are well known; therefore it is sufficient to mention that certain peculiar intracellular corpuscles discovered by Negri in 1903 are now considered diagnostic signs of the disease, if found in the brain of suspected dogs or other animals, and that the virus shows a peculiar affinity for the nervous system, though also found in the secretion of the salivary, lacrymal and mammary glands, and occasionally in the blood and inner organs. The germ will retain its virulence if kept in the dark for months, if not years.

Small-pox, Vaccinia, Milk-pox (Amaas), Varicella.

In 1905 Negri and later in 1906 Nicolle and Adil Bey showed that vaccinia—that is the lymph used in vaccination — retains its properties after passing through a Berkefeld filter and the coarser grades of a Chamberland filter. These filtration results have been contradicted by numerous other observers, including Thomson (1924). But there can be no doubt that given suitable technique (dilution and partial discrete maceration) the experiment succeeds, as shown quite lately (1925) again by Mervyn H. Gordon, who states conclusively that "Vaccinia, therefore, is now definitely included among the filtrable viruses."

In 1908 Casagrandi confirmed the filtrability of the virus of smallpox—variola, as might be expected because the two viruses, if not identical, are at least very closely related. The virus of the third disease of this group, variously called milk-pox or mild small pox, varioloid, alastrim, or amaas, is also filtrable (M. H. Gordon). It differs from vaccinia in so far that it fails to "take" in the rabbit or calf, but can be made to do so after repeated passages through monkeys.

Whether these three viruses are identical and their virulence simply slightly altered by passages through various animals is a matter which has been fiercely contested since the days of Jenner and it cannot be said is yet completely decided, because individual opinions as to the meaning of the word "identical" and "different" vary considerably. Jenner has already observed that one could inoculate cow-pox and small-pox at the same time and produce a "mixed" disease, for the principal difference between the two is that vaccinia remains localized and small-pox spreads in man. In Jenner's observation the mixed variola-vaccinia in the course of six months became completely vaccinial, for the small-pox virus had died out.

M. H. Gordon's report (1925) gives full information on these matters, though his investigations are not yet completed.

Varicella or chicken-pox is not only clinically but also experimentally a different disease altogether, its virus is not inoculable to laboratory animals, and in various precipitation tests has been shown by M. H. Gordon to be sharply differentiated from vaccinia and variola.

The group of "pock" disease in man and animals is great and most of them appear transmissible from animals to man by the method of cutaneous scarification. Jenner figures a cutaneous vaccination in a child with pus from the heel of a man suffering from horse-pox (I believe also called heel-grease—*germane* Pferde-Mauke); and diseases of the same group are known in the sheep-dog, goat and also birds, and though their naked-eye appearance is very similar the viruses are distinguished by experiment and cross immunization by inoculation.

Before concluding it may not be without interest to call attention to the fact that the cerebral localization of vaccinia has been clinically noted in very rare cases, the symptoms resembling tetanus.

Trachoma is a widely spread infective, chronic human conjunctival disease which soon renders the palpebral conjunctiva thick and velvet-like. It also spreads to the cornea and often, even if cured, leaves behind scars and opacities. In certain chronic conditions it is extremely difficult to differentiate from other similar ophthalmias.

Bertarelli and Cecchetto in 1907 inoculated a macacque monkey with the filtrate from the granulations of another monkey which had been previously infected with human trachoma virus and thus reproduced the disease in series.

Trachoma bodies or Prowazek-Halberstädter bodies are small chlamydozoic structures and a constant

feature of early cases. Later invading bacteria render the search and recognition very difficult.

The researches undertaken on these various animal and human diseases prove that filter-passers are selective in their pathological action on the animal body; that is they show a definite tendency to attack certain groups of cells, and cause in the beginning alteration in those cells and those only. Later bacteria join in the fray and conditions can with difficulty be distinguished from generalized bacterial invasions—witness the experience with hog-cholera and swine-fever and various forms of dog distemper.

VII.—Neurotrope Viruses.

We now come to a group of human and also animal diseases caused by filter-passing viruses which have not yet been experimentally clearly differentiated and classified. The diseases they cause are clinically fairly distinct; pathologically the common tendency is to attack the central nervous system and cause certain definite alteration, especially in the nerve cells and around capillaries.

Rabies has certain affinities to the group and to a lesser extent also the virus of mumps; though the latter may be due to a minute spirochæte. Rabies, however, does not cause the histological alterations in the central nervous system which have been shown to occur as the result of infection with a true neurotrope virus, and in addition has already been considered under diseases transmissible from animals to man.

In animals there is a big group of diseases of the central nervous system which appear epizootically, are evidently infectious, and result in paralysis and rapid muscular atrophy; examples are Borna's disease in horses, Aujeszky's disease in cattle and similar spontaneous infections of goats, rabbits, guinea-pigs (Jonescu-Mihaiesti), though some which to all outward appearances should belong to this group, are either due to protozoa or obscure causes.

Poliomyelitis.

The first human disease of this group to be clinically recognized and studied was poliomyelitis, the well-known acute febrile disease of children and young adults, which results in a more or less extensive paralysis and rapid atrophy of muscles, especially of the lower limbs.

Pathologically, the lesions of the brain and spinal cord consist in perivascular round-celled infiltration (cellular cuffs), small hæmorrhagic foci in the grey substance, meningeal inflammatory processes, leucocytic groupings and above all cytolysis of the big motor cells of the anterior horns of the spinal cord, which in chronic cases progresses to a condition called "neuronophagia" by Levaditi.

The virus of poliomyelitis proved eventually to be filtrable and transmissible to monkeys, but before this conclusive result was obtained, numerous bacteria and in some cases even protozoon-like micro-organisms were isolated and published so that in some instances investigators came to the conclusion that infantile paralysis could not be a pathological entity, but was due to a variety of causes. In fact Hoche in 1890 had considered he could produce the cerebral lesions of poliomyelitis by the injection of inert substances and bacteria into the veins of rabbits. This result is due to the common confusion of "general resemblance" with "major signs." Later, in 1908 Allen Starr and Martha Wollstein examined cerebro-spinal fluids of twenty cases of poliomyelitis and definitely stated that artificial cultures on various media aerobically and anaerobically remained absolutely sterile.

In 1909 Landsteiner and Popper succeeded in transmitting the virus of poliomyelitis to two monkeys, which became paralysed six and seventeen days after the inoculation of minced and emulsified spinal chord from a typical case of poliomyelitis in a child of 9 years. Rabbits, guinea-pigs and mice were unsuccessfully injected in the same time. Transmission of the virus from the two monkeys also failed.

Similar results were obtained by Knöpfelmacher in 1909, but in the same year practically simultaneously Flexner and Lewis in New York, Leiner and Wiesner in Vienna, Landsteiner and Levaditi in Paris, succeeded in transmitting the virus to a monkey and from this one to others in series. The inoculation of the human virus to rabbits, guinea-pigs and many other animals has so far failed or given uncertain or frankly fallacious results.

The filtrability of the virus of poliomyelitis was also practically simultaneously discovered in Vienna, Paris and New York, by Leiner and Wiesner, Levaditi and Landsteiner, Flexner and Lewis. The incubation of the disease in monkeys injected with a filtrate is longer than when an emulsion of nervous tissues is used—this may show that the virus is retained to a great extent by the filter.

Levaditi has artificially cultivated the virus together with monkey nerve-cells and produced poliomyelitis in monkeys with the fifth transplant of such virus, which will remain virulent for three weeks.

Pieces of medulla placed in 50 per cent. glycerine will retain their virulence for 202 days at least according to Landsteiner, Levaditi and Pastia—and according to Flexner and Amoss as long as six years!

Heat at 50° C. during one hour will kill it, but temperatures below freezing are supported for a considerable time. Virus kept for twenty-five days in milk was attenuated but not destroyed.

Pieces of spinal cord will resist drying over potash at 22° C. for twenty-four days; if the drying is done in vacuum over sulphuric acid pathogenicity will be retained for a fortnight at least.

Antiseptics destroy the virus in the usual surgical solutions and strength, though thymol 1 per cent. and carbolic 0·5 per cent. show but slight action. The simplest and most effective *in vitro* disinfectant for the virus of poliomyelitis appears to be a 1 in a 1,000 solution of permanganate of potash, which is also very effective in relation to the virus of vaccinia (Mervyn Gordon, 1925).

The practical application of these experimental observations lies in the established fact that the virus

may be present for a considerable time in the naso-pharyngeal cavity of children who have suffered from the disease, not only that but " carriers " may harbour the virus in their naso-pharynx without developing clinical symptoms and thus infect others ; in addition infection takes place through the oral cavity and nose, and thus a simple and non-toxic mouth-wash is indicated.

Levaditi and Landsteiner have observed the gradual loss of virulence in the course of numerous serial passages through monkeys. This is not an uncommon experience when dealing with filtrable viruses, in general, and to my mind explains the dying out of epidemics of poliomyelitis and encephalitis.

Diffusion of the disease takes place through contact or the intermediary of soiled objects; the common *Stomoxys* mechanically disseminates the virus and has been proved to do so experimentally. It is still doubtful whether it does so in nature. Epidemics usually develop in summer and early autumn, and subside during the winter.

In view of the well-known resistance of filtrable viruses to drying, dust must be viewed with evident suspicion, and indeed Neustadter and Thro induced poliomyelitis in a monkey by injecting it with 50 grm. of dust from the room of a patient with poliomyelitis. Stable flies, bugs, lice, fleas, have also been investigated as possible carriers of the disease, but with the exception of stable flies results have been negative. We have, however, seen that contact and the existence of carriers are quite sufficient to explain the spread of an epidemic of poliomyelitis, though admittedly most striking exceptions have been noted, where diseased children have been in contact with over fifty others, and no other case has developed.

The virus is therefore as selective in the individual it attacks as it is in the selection of the cells it invades.

Flexner and Noguchi have succeeded in artificially cultivating minute " globoid bodies," which are just visible under the microscope in the shape of short chains or clumps, which can be stained by eosin-azur. In this the virus differed from many other filter-passers, for so far they have not yielded cultures *in vitro*.

Filtrable Herpetic Virus.

Here we approach a very big group of viruses, which may eventually prove to be one single virus with numerous degrees of virulence or several slightly different filter-passers.

In 1913 Gruter, by infecting the cornea of a rabbit with material from a corneal ulcer of a man, produced the same pathological alterations, namely phlyctenular kerato-conjunctivitis.

These results were confirmed in 1919 by Löwenstein, who showed that the virus from all herpetic lesions is pathogenic for the cornea of rabbits with the exception of herpes zoster or shingles. Numerous other observers found these observations correct, but Luger and Lauda in 1921 proved that the virus of herpes was filtrable, though the filtrate is less active than the original material.

Blanc and Caminopetros (1921) showed that genital herpes in man is produced by a virus which is invisible, non-cultivable and filter-passing, which at times is capable of localizing itself in the brain of experimentally infected rabbits and causing encephalitic symptoms and signs, though the cornea only was originally infected. In other words, though the virus in man causes visible pathological lesions of the epithelium, in the rabbit the same virus shows definite neurotropic tendencies. Luger, Lauda and Silberstein (1921) investigated numerous filtrates from herpetic vesicles which developed in the course of numerous feverish conditions such as pneumonia, chronic lung tuberculosis, endocarditis, meningitis, middle-ear disease, &c., and found they were all pathogenic for the cornea of the rabbit. Corneal inoculations with control material from other sources gave no result.

Guinea-pigs were found to be equally suitable for experiment. The virus was found to be active in dilutions of one in a thousand, but varies very considerably in its virulence. In the course of transmission from rabbit to rabbit it may increase. Some attack the cornea alone, others will readily spread to the central nervous system; as a rule in the animals infected it can be detected in the blood, the spleen and central nervous system.

Cases have been observed where herpes was present on the lips, but no virus could be detected in the saliva, and vice versa saliva of apparently healthy persons was found to contain the virus.

Ravant and Rabeau inoculated the cornea and brain of rabbits with cerebro-spinal fluid from cases of herpes with a positive result.

The outcome of all these researches is that in numerous instances one can detect a filtrable virus whose presence makes itself remarkable only in the course of an infection caused by some definitely known bacterium; its relation to the virus of epidemic encephalitis is discussed later on.

Encephalitis Epidemica Lethargica.

This disease had apparently been observed in Italy in the fourteenth century, later at Tübingen in 1712, and again in Italy, Austria and Switzerland about 1890. It is very probable that single sporadic cases have existed in Europe ever since, but the first complete, exhaustive clinical study was published by von Economo in the course of a small outbreak in Vienna in 1917. In England it was recognized early in 1918, and since then the dread disease has spread over a good portion of the inhabitated globe. The symptoms of the disease can be divided into acute, chronic and after-effects or sequelæ. Its infectivity is low, but of long duration—outbreaks in institutions have been described, physicians and nurses have contracted the disease from their patients, mothers have been known to infect their babies, in fact several cases have occurred in a household.

The sequelæ, after-effects or residues are most important, as they occur in one form or another sooner or later in proportions varying between 50 to 75 per cent., according to different authors. These

ate manifestations consist in the Parkinsonian syndrome in some and a profound alteration in character amounting to evident mental disease in many others.[1]

The search for the causal agent proved difficult and is still being continued, because numerous similar viruses appear to exist in man and animals, which though they give rise to clinically distinct symptoms in the course of a natural or epidemic infection, when injected into rabbits or monkeys in various fashions may be followed fairly constantly by a diffuse encephalitis, microscopically very similar to the human disease. Not only does the virus of human encephalitis belong to this group, but also that of febrile herpes, and another studied by Bull, Oliver, Wright and Craighead and found to be a filter-passing germ about one-fifth of a micromillimetre in size which produces both naturally and experimentally a mortal encephalitis in rabbits.

Moreover, C. C. Twort and Archer described a diffuse encephalitic condition in the rabbit which Levaditi eventually considered to be due to a minute sporozoon called *Encephalitozoon cuniculi*.

All these pitfalls and disturbing factors have only extended the number of researches and confirmatory experiments, but cannot invalidate the main results, any more than the ubiquity of spirochætes has stayed the triumphal march of discoveries and clinical applications which followed the detection of the *Treponema pallidum*.

It may however be mentioned that Wiesner in 1917 originally isolated a diplo-streptococcus, Löwenthal and also Manteufel reported the finding of influenza bacilli, whilst Rosenow and Jackson found cocci in short chains in every one of twenty-one cases. James and McIntosh (1918) recorded negative cultural results from eight fatal cases. These short notes prove some of the difficulties of experimental research in this branch of medicine; there are many others.

Early in 1919 Strauss, Hirschfeld and Loewe (New York) published the results of experiments with a *Macacus rhesus* which had been inoculated intradurally with brain emulsions from a case of epidemic encephalitis, and, later, on rabbits injected with the naso-pharyngeal washings from patients with the same disease. The results were positive with the monkey, that is, the animal thus infected died in a few days with a diffuse analogical encephalitis which could not be transmitted.

The lesions in the rabbits were not very conclusive, and we now know as the result of the extensive investigations of Levaditi and his many collaborators that rabbits do not get easily experimentally infected with human virus, but that after passage through a monkey the virus may assume pathogenic properties for rabbits.

In 1920 Levaditi and Harvier by crushing and grinding up the brain substance of a woman who had died of encephalitis lethargica and who in addition presented symptoms of herpetic disease (herpes febrilis), produced by intradural injection a condition of encephalitis in a rabbit which ended in death. By transmitting this encephalitis in series through other rabbits they succeeded in obtaining a virus which passed a Chamberland candle and whether inoculated into cornea, skin, intravenously or intracerebrally, gave rise in each case to keratitis and eventually encephalitis

These results are complicated by the disturbing factors already suggested, but the experiments of Levaditi and his numerous collaborators have now been repeated so often and in so many different fashions, and also confirmed by many other investigators, that it is impossible to uphold many objections which have been raised in the past.

In 1919 McIntosh and Turnbull injected emulsified brain substance from a case deceased at Derby into the brain and peritoneal cavity of *Macacus rhesus*. In addition part of the emulsion was passed through a Berkefeld filter and injected in the same fashion into a *Cercopithecus patas*, who died two months afterwards with hæmorrhagic lesions and diffuse encephalitic symptoms.

Netter, Cezari, Durand (1921) inoculated the filtered brain emulsion and also salivary glands from a fatal encephalitis case which had lasted fifteen months and obtained a positive result.

Kling (1922) confirmed this result with the cerebrospinal fluid of a case of post-encephalitic paralysis agitans over eighteen months after the acute onset of the disease. Sicard, Paraf, Laplane (1923) injected a rabbit with mesencephalic emulsion from a case of post-encephalitic Parkinson's syndrome which ended fatally four years after the acute onset of the original symptoms, and even then obtained a positive result.

These observations are extremely important, for they prove how long these filtrable viruses can persist in the system, and, we surmise, remain virulent and transmissible to new victims given suitable circumstances.

Encephalitis lethargica being thus due to a selective filtrable virus, it was to be expected that in common with rabies and Borna's horse encephalitis it should give rise to a typical cellular reaction of a chlamydozoic nature.

In 1919 Da Fano and Ingleby described minute granules in the protoplasm of nerve cells; later Da Fano detected them intra- and also extra-cellularly. In 1923 he produced meningo-encephalitis in the rabbit with virus from herpes febrilis and found in the brains of the animals similar corpuscles. Luger and Lauda in 1921 described similar bodies in spontaneous human herpes febrilis.

Hume, Nattras and Shawe (1921-2) detected Da Fano's corpuscles in four fatal cases, and later (1922) Levaditi, Harvier and Nicolau described "encephalitic neuro-corpuscles," which they detected in 13 per cent. of the brains of animals experimentally infected with encephalitic virus.

In 1920 Loewe and Strauss reported that they had isolated on Noguchi's medium a minute germ, from

[1] I should like to acknowledge my indebtedness to the book on epidemic encephalitis by Arthur J. Hall (1924) for much valuable information on the clinical aspects of the disease.

the brain, naso-pharynx and its washings, spinal fluid and blood of fatal cases of encephalitis. The filtrable artificial culture reproduced the disease in rabbits and monkeys, could be recovered in pure artificial culture from their brains, be re-inoculated in series and preserved its virulence for several months in 50 per cent. glycerine. This is a striking discovery, because we have seen that multiplication of virus does not usually take place outside a living cell.

Levaditi (1922) has shown that among laboratory animals the one most easily infected is the mouse, which can contract the disease whether inoculated intradurally, intraperitoneally or under the skin. The white rat, sheep and fowls appear to resist the infection, and the rabbit and guinea-pig are not always easily infected with human virus.

Levaditi, Harvier and Nicolau (1922) showed that small pieces of brain of rabbits can be dried for forty-four days over phosphorus pentoxide, be pulverized and yet remain virulent. Brain substance can also be emulsified to a dilution of one part in a thousand and yet remain virulent. Heated for one hour at 55° C. it is destroyed. Bile which has but slight influence on the virus of poliomyelitis will inhibit its pathogenic qualities. Among antiseptics permanganate of potash (one in a thousand) has a definite disinfectant action.

The virus can be kept active for ninety-six days in milk at room temperature and for a fortnight in water and will remain virulent for forty-eight hours after death.

Levaditi after numerous cross-experiments on rabbits came to the conclusion that epidemic lethargic encephalitis is due to a specific filtrable virus which, however, exists in four degrees of virulence:—

(*a*) Attenuated in the saliva of healthy subjects where it appears to be fixed to the epithelial cells of the mouth.

(*b*) A slightly virulent form in the blebs of herpes.

(*c*) Very virulent form in the saliva of healthy "carriers."

(*d*) Similar virulent form in the central nervous system of encephalitic patients.

He thus considers the virus of herpes, which is widely spread, identical with that of epidemic encephalitis, and differing from it only in degree of virulence and specific attraction for the nervous system.

Spinal Amyotrophy.

This is a familiarly occurring disease of a definite hereditary character, which many of us, obsessed as we are by the idea of what a bacterium is, can, and cannot do, could never admit as being possibly due to a "germ." It must be cellular metabolism, dysgenic factors, original sin or nothing.

Therefore Levaditi, Landsteiner, Pratch and Zatelli themselves view with a certain measure of philosophic doubt the striking result they obtained in two monkeys which in 1911 they inoculated with an emulsion of the spinal cord of a child suffering from the disease, but who had died of pneumonia. After an incubation of a month the monkeys fell ill and died. Microscopically the spinal cord showed perivascular cuffs, small focal inflammatory reactions in the grey matte and advanced cytolysis in the motor cells.

This observation may be correct or vitiated by som intervening factor such as the ubiquitous herpet virus; but this can be definitely stated—filtrab viruses have a pathology of their own, and in th vertebrate body behave in a peculiar fashion of the own for which an analogy cannot always be foun at least in bacterial bionomics. The spirochæte syphilis does approach filter-passers in its chronicit prolonged latent periods, and selective, if at time erratic, localizations. It differs in its protean manifest ations (examples—condyloma, gummas, aneurysm tabes, general paralysis), for filtrable viruses are fairl constant to type, and above all fairly consistentl selective in the tissues they invade; which thus lead up to the thought that not only they are cellularl selective, but consequently pick out certain individual or families or races.

The subject possesses considerable clinical import ance, for transference through the placenta is possibl for filtrable neurotropic viruses.

It is known and admitted that encephalitis letha gica leads to symptoms simulating Parkinson's disea or paralysis agitans, also that it may cause alter tions in the moral character amounting to ment affliction. It is not too far-fetched therefore t suggest that some forms of idiocy, epilepsy an dementia præcox may yet be found to be residues o after-effects of viruses similar to the ones we hav reviewed.

VIII.—Influenzal Catarrh and Filter-passers.

In 1918 Nicolle and Le Bailly, later Selter and M. H. Gordon, detected in the nasal secretions o patients suffering from influenzal catarrh a filtrat capable of reproducing the disease in human beings These results have been confirmed by several Japanes scientists—Yamamcuchi, Hivashina, Sokokami; bu later, in 1922, Olitzsky and Gates succeeded in cul tivating on Noguchi's medium a small body whic they called *Bacterium pneumosintes*, whose size i just above the limits of ordinary microscopical visi bility—a tenth of the thousandth part of a millimetre

Pure cultures produce in the rabbit pathologica appearances consisting in œdema, emphysema, capil lary hæmorrhages, symptoms evidently occurring in human influenza, a disease, however, in which super added massive infections with *B. pfeifferi* and in other cases various diplococci and streptococci play a great part.

In any case *B. pneumosintes* is visible, cultivable and shows no definite predilection for any type o cell, and produces no peculiar reactive bodies (Chlamy dozoa). It may yet have to be grouped separately from other filter-passing viruses and perhaps be foun to be akin to the germ of peri-pneumonia in cattle.

Thus W. L. Holman and F. H. Knock have bu lately described a minute anaerobe which passe through Mandler, Berkefeld N. and W. filters, whic they recovered from the mouth cavity of thirteen

people, three rabbits and a guinea-pig. It is a definite bacterium and they consider it very similar to if not identical with *B. pneumosintes*.

On the other hand there is an analogy with hog-cholera and swine-fever, owing to the pullulation of definite bacteria which play a conclusive part in the symptoms and also prognosis of the disease.

IX.—Molluscum Contagiosum and Warts (Verrucæ).

For many years the communicability of molluscum contagiosum had been clinically known and carefully observed, but the first experimental transmission in the human subject by means of a filtrate was published by M. Juliusberg in 1906, who filtered the suitably diluted juice from the molluscum of a woman and, having passed it through a Chamberland filter, rubbed the filtrate into his own forearm and that of two other colleagues after slight abrasion of the skin with sandpaper. In one case fifty days after the inoculation about sixty definite mollusca appeared, which on microscopical examination showed the well-known molluscum bodies. In 1907 Serra repeated and confirmed these experiments.

Ordinary warts, the variety which are well known on the hands of schoolboys and schoolgirls, are due to a filter-passing virus. Their contagious nature has been suspected for centuries, and Payne in 1891, Gemy in 1891, Barthelemy in 1896, &c., have published cases clinically proving the transmission of warts from one individual to another, whilst on the other hand, world-famous dermatologists like Hebra in 1866 and Kaposi at the end of last century have considered such reports as old wives' tales. Variot, however, in 1894 inoculated warts from a child to an adult, and Jadassohn in 1895 demonstrated at a dermatology congress warts he had experimentally grafted on his own hand and that of his assistant.

G. Ciuffo, however, in 1907, using the filtrate obtained from warts of the hand of a young workman, inoculated his own hand and noted the development of typical flat warts at the end of five months.

A. Serra has lately carried out a series of experiments with the filtrates of papilliform vegetations from the preputial fold of a peasant 19 years of age and obtained a positive result on his own hand and on the hand of the patient from whom the virus was obtained, but instead of condylomatous growths he obtained simple warts after an incubation of about five months which took about two other months to attain full size. Animal experiments on rabbits, guinea-pigs and dogs were unsuccessful. It is however known that foxhounds develop warts on the mucosa of the mouth, and these are easily transmitted by filtrates (Findlay 1925).

Only a few weeks ago (November 1925) Dr. G. M. Findlay, of the Imperial Cancer Research Laboratories, demonstrated at a meeting of the Royal Society of Medicine warts he had produced on his hand by inoculating a Berkefeld filtrate of the venereal warts from the penis of a waiter from Soho. The incubation was prolonged over sixty days, and the type of wart produced did not correspond to that of the original one, which was papular.

At the time it was mentioned that Dr. A. J. Murray had also been inoculated at the same time but with no visible result.

These experiments are mentioned in view of their importance and possible bearing on the question of cancer ætiology, even if they are only applicable by way of analogy, but the long period of incubation and varying susceptibility of different individuals should be noted.

Some epithelioid warts are histologically true epitheliomata in so far that they consist of epithelial elements only with a slight scaffolding of fibrous elements. They differ of course from malignant epithelioma or cancer by their discrete growth, lack of metastatic deposits and absence of infiltrative diffusion.

X.—Virus Diseases Conveyed by Arthropods.

Leptospirosis.

First among these yellow fever requires consideration, for at one time it was a death-dealing, widely spread human disease (Yellow Jack), whose inclusion among filter-passers is justified by the fact that the virus does pass a Berkefeld, though in reality it is a *Leptospira*, an extremely delicate and minute spirillum similar to the one found free-living in water (Hindle 1925).

In 1902 a commission of U.S.A. doctors (Reed, Carrol, Agramonte, Lazear) studied yellow fever in Cuba and infected human volunteers with a filtrate of the blood of patients taken between the first and third days. Three other Commissions—two U.S.A. and one French—could only confirm these results, but failed to detect the spirillum, though Schaudinn before his death in 1906 had foreseen its existence and discovery, which indeed was accomplished by Noguchi in 1917.

We now know that the mosquito *Ædes argenteus* (*Stegomyia fasciata*) in sucking the blood of the patient also absorbs the *Leptospira icteroides*, which then apparently passes through a stage during which it is invisible or breaks up into minute granules (A. Balfour); after twelve days the mosquito is infective. The *Leptospira icteroides* is a filter-passer in so far as it goes through Chamberland and Berkefeld filters, but the clinical type of the disease is that of other leptospirosis-like ictero-hæmorrhagic diseases, autumn fever (due to *Leptospira hebdomadis*) and infections of a similar nature. The germ itself is not so resistant as the virus of chlamydozoic microplasms, as it is killed by exposure to air at a temperature of 24° to 30° C. in forty-eight hours, and does not survive drying.

Dengue is a febrile disease of tropical and subtropical countries, characterized by severe pains of joints and back, a short partial recovery and then relapse, which after a couple of days terminates the illness. The mortality is low. That it is due to a filtrable virus was discovered by Ashburn and Craig (1907).

Sand-fly fever or three-day fever is a similar benign fever of three days' duration, transmitted usually by

Phlebotomus papatasii or similar sand-flies. The blood on the first day is infective and the virus was discovered to be filtrable by Doerr (1908).

Epidemic parotitis is a clinically well-known disease, and Granata in 1908 obtained from the saliva of children suffering from mumps a filter-passing virus which when inoculated into the blood, parotid gland and subcutaneous tissue resulted in a rise of temperature and a swelling of the parotid gland of one or two weeks' duration. Mervyn Gordon in 1914 then used also a filtrate of the saliva for the intracerebral inoculation of monkeys. Four of the animals died with meningeal symptoms within four days. One monkey inoculated intraperitoneally and intravenously became ill on the eleventh day with swelling of the parotid gland, but no nervous symptoms. Attempts to transmit the virus in series failed.

M. Wollstein (1916) repeated the experiments with cats into whose parotid gland and testicles she injected a filtrate of the saliva of children in the active stage of mumps. After an incubation of five to eight days the inoculated glands became swollen and tender, these symptoms persisting several days.

M. Wollstein in 1918 made further experiments on cats with salivary fluids taken from adult cases in a parotitis epidemic in the military camps near New York City, and found that the virus was a filter-passer, and detected most readily in the saliva during the first three days of the disease, less easily on the sixth day and not at all on the ninth day. It was also detected in the blood of patients showing marked constitutional symptoms and in the saliva of a case of recurrent mumps at the periods of enlargement of the parotid glands, but not two weeks after the swellings had subsided. It was not detected in the cerebro-spinal fluid. She carried out experiments in series and examined histologically the parotid glands and testes of the cats inoculated, finding alterations corresponding to those described in mumps.

Recent researches of Y. Kermorgant have resulted in the detection of a spirillar micro-organism in this disease, but these observations are yet too recent for confirmation, though orchitis and parotitis in monkeys were produced by inoculations with the culture of this spirochæte.

The spirochætal diseases of man and animals of the relapsing fever type, due to a spirillar micro-organism which under circumstances will go through certain coarse-grained filters, need only a passing reference to the variety of arthropods which convey the diseases, including as they do lice and various ticks.

No account of leptospirosis would be complete without a mention of rat-bite fever, which is due to *Spirillum minus* (*Spirochæta morsus-muris*) and also to the peculiar epidemic icterus due to infection with a similar leptospiral micro-organism—no doubt closely allied to the one found free-living in water and fairly easily cultivable in a mixture of fæces and water.

A small outbreak I had occasion to observe in two children of a family, and a young lady aged 24 who lived in the house where the icteric disease was contracted, to my mind was connected with contamination of the food through mice, which had penetrated the fly-proof larder through a small hole in the netting. Mice harbour spironema in their fæces and also blood, and at one time Gaylord, having found the spirillar bodies in cancerous mice, thought the organisms might be the cause of cancer

From an epidemiological standpoint it will be noted that the spirochæte genus is disseminated, transferred or multiplies in several different fashions, which can be summarized as follows:—

(1) Contact (syphilis); (2) diptera (yellow fever); (3) lice (Russian relapsing fever); (4) ticks (African relapsing fever, also fowl spirochætosis); (5) rodent's bite (rat-bite fever); (6) contamination (leptospirosis); (7) innocuous parasitism or infestation (*Spirochæta dentium*)—and in addition are found free-living in water.

In addition their pathogenic properties are comparable in many ways with those of ultramicroscopic viruses in their—(1) filterability; (2) difficult artificial cultivation and isolation; (3) long period of latency in certain diseases (syphilis); (4) transmitted by animal bite like rabies; (5) hyperplastic action on certain definite tissues; (6) individual pathogenicity—syphilis, relapsing fevers, yellow fever; (7) bacterial relationship.

For these and several similar reasons it has often been suggested that all filtrable viruses consist of extremely minute and delicate spirochætes beyond the range of visibility.

Typhus Group of Diseases (*Rickettsia*).

The inclusion of the typhus group of diseases among those caused by filtrable viruses is perhaps artificial. Early experiments showing that the virus of the disease would pass a filter are not of a conclusive nature, but Nicolle in 1920 stated that he considered typhus to be due to an ultramicroscopic virus, though he admits that so far the opinion lacks definite experimental confirmation; he explains, however, that he considers the virus to be so firmly intracellularly situated that it cannot be detached from the protoplasm and so pass a filter. In support of this view he reports the following observation: On centrifuging virulent blood it will separate as usual into three layers—the lowest consisting of erythrocytes with a milky coating or film consisting of white blood-corpuscles and then serum. If the erythrocytes are injected into a monkey they are found devoid of all virulence; the serum under the same circumstances may or may not be active, but in every case the leucocytes are highly virulent—one cubic millimetre being sufficient to cause evident pathological symptoms, whilst a dose of erythrocytes 2,500 times larger will have no effect.

Nicolle also admits that the objection might be raised that bacteria circulating in the blood would naturally tend to collect among the leucocytes; so they would, but hardly in such a strikingly selective fashion.

A disease which has several points of resemblance with typhus fever is trench or Wolhynian fever, which Strong (1918) considers to be due to a filtrable virus, and this disease in common with others of the typhus group has an arthropod as intermediary—the ordinary louse.

The typhus group, though not comprising many human diseases, is widely spread, and the insect vector is not in all cases the same, but varies in different continents. Typhus has been known for centuries in Europe, and is still endemically present in Russia and Poland, in addition to North Africa.

In this instance the virus appears to be conveyed by the common louse *Pediculus humanus*, in its varieties *capitis* and *vestimentorum*. This also applies to tabardillo in Mexico—the local name for typhus. A similar fever described by Megaw in 1921 as occurring on the lower folds of the Himalayas is also disseminated by lice. Rocky Mountain fever, also called black fever or blue disease, from certain districts of Montana and Idaho, U.S.A., is apparently transmitted by a tick, *Dermacentor venustus*. Japanese river fever, kedani mite disease, which occurs in Formosa, Korea and in the Nippon Island of the Japanese Empire, is due to the kedani mite, the larva of *Trombicula akamushi*, similar to our harvest-bug, *Leptus autumnalis*.

All these human diseases are connected with the appearance both in the capillary endothelium of the persons affected by the disease and in the gut of the arthropods conveying the virus of minute peculiar bipolar bodies which so far it has been impossible to classify either among bacteria or protozoa. Rocha-Lima of Hamburg, who fully investigated and described them in 1916, proposed the name Rickettsia, after H. T. Ricketts, who first discovered very similar bodies in the blood of patients and fæces of lice in the course of investigations he was carrying out in Mexico City, where he contracted tabardillo and died.

It is worthy of note that Ricketts saw the bodies in blood, where they are very scanty, and considered them difficult to find in lice, where on the contrary they are usually present in enormous numbers.

Rickettsia prowazeki, which is considered by Wolbach (1922) to be the causal agent of typhus, shows a conclusive, selective predilection for the vascular endothelium cells of infected persons. In infected lice, that is lice which have been fed on typhus patients, it is found usually in massive numbers, filling the protoplasm of the cells of the alimentary tract. They may multiply to the extent of causing the cell to burst, and thus get extruded into the lumen, but their typical position is within a cell.

It must be explained that about twenty different rickettsias have been described occurring in arthropods (insects, Arachnida and Acarina), the majority of them appearing to be harmless parasites of their invertebrate host.

Nöller (1917) discovered a *Rickettsia* in the "ked" of sheep (*Melophagus equinus*). This one has apparently been artificially cultivated on glucose blood-agar medium, but all others have so far resisted artificial isolation.

The position of *Rickettsia* is still uncertain, though on the whole the tendency is to consider them bacterial in nature—in this they resemble certain spirochætes.

Arkwright, Atkins and Bacot (1921) have described bacillary and filamentous forms as part of the developmental cycle of a *Rickettsia*-like parasite of the bed-bug.

Lice also harbour what appear to be a harmless parasite of the *Rickettsia* type, which is distinguishable by its constant extracellular situation in the lumen of the gut, where it multiplies. This is considered a separate variety—*R. pediculi*.

Trench fever has also been considered to be a rickettsiasis, and a laboratory infection appears to confirm this view.

A. Bacot in 1920 contracted trench fever in Warsaw, and thereupon lice fed on his body showed very numerous extracellular rickettsias within three weeks of his developing the fever; this though the same lice for two years had been known to be free from rickettsias. A. Bacot continued to infect clean stock lice fed on his person long after his recovery, in fact three months after the disappearance of all symptoms, four months after his initial attack.

The acceptance of *Rickettsia* as the causal organism of typhus and trench fever makes an explanation of the filtration experiments difficult without further knowledge of its bionomics. Animal rickettsiases are not unknown—Nuttall produced paralysis in a goat by the bites of a tick infected with *Rickettsia*, and Cowdry lately discovered that heart water in sheep in South Africa was due to endothelially situated rickettsia, transmitted by the "bonte" tick *Amblyomma hebraeum*.

XI.—Neoplasms, Parasites and Viruses.

The scepticism of all branches of the medical profession with regard to the existence of a parasitic cause of cancer can be summed up in the words: If cancer were due to a parasite it would have been detected long ago, and in addition we should have cancer epidemics.

Arguments on these lines are sterile. Has the bitter strife about the parasite of malaria been forgotten, the pseudoscientific proofs backed by famous names, which showed it to be an artefact or a ubiquitous micro-organism which could be found in water and mud, the clinching evidence of places with mosquitoes and no malaria and in the alternative of malaria with no mosquitoes?

When Schaudinn first announced and demonstrated his discovery of the *Spirochæta pallida* as the micro-organism of syphilis at a meeting in Berlin, someone, who shall be nameless, got up and said, most urbanely but firmly and with authority, that he had seen and heard in the course of twenty-five years exactly twenty-five different parasites accused of being the cause of syphilis, and then watched them fade away into a deserved oblivion, He knew the same would happen to the twenty-sixth. Has it, though?

If cancer is due to a virus or microplasm, further experimental proof will be forthcoming sooner or later, but it must be understood that great, really great clinical observers were not adverse to entertaining this view of the parasitic nature of cancer.

Sir James Paget, with the polished diction we may well envy and strive to imitate, expressed these views

in a lecture "On Cancer and Cancerous Diseases" in 1887:—

"I believe that micro-parasites, or substances produced by them, will some day be found in essential relation with cancers and cancerous diseases. Mr. Ballance and Mr. Shattock have indeed lately failed to find any; and if, in such a question as this, negative evidence could prove a negative, certainly theirs might make us hopeless. I would not be so, especially if workers so earnest and so skilful as they are will continue the search."

That cancer usually develops in individuals over forty is a disconcerting factor, and many other observations which at present appear inexplicable from a parasitological standpoint have been made; but pathology has presented and still presents many similar riddles which even in my time have been solved or are being partially and gradually explained. Let us call to mind general paralysis of the insane—we now definitely know that it is a late syphilitic manifestation with spirochætes in the brain substance; but twenty-five years ago its age-incidence was often adduced to prove its non-syphilitic origin.

It has been stated often enough that all speculative thinking is to be deprecated, but experiment without speculative direction is like firing without aiming, and accordingly one may shamelessly state what one considers the parasite should be like, for in this case to use a mathematical similitude we have one incognitum to solve and numerous equations to do it with.

Accordingly one imagines that "it" would comply with the following conditions:—

(1) Extremely minute, so as to escape recognition under the microscope; and/or stain with great difficulty with the usual methods. As a third hypothetical alternative it might closely resemble some well-known cellular element so as to be easily mistaken.

Not artificially cultivable on ordinary bacteriological media.

For evident reasons, it does not seem possible that so many years of intense microscopical and bacteriological observation should not have detected any recognizable typical structure.

(2) Should be strictly specific for one sort of cell and multiply in those cells only.

Why? Because malignant growths though very numerous and varied, are true to type and even the most intense infiltration of tissues or the extensive dissemination of metastatic deposits never gives rise to tumours different from those of the original growth; in fact real "mixed" tumours are very rare.

(3) Its pathogenic properties should vary within wide limits and it should be capable of remaining quiescent, smoulder for several years and then flare out afresh.

Examples: The sudden acquisition of pathogenic properties in moles (melanotic carcinoma) or chorio-epithelioma; late recurrences.

(4) Not sufficiently toxic to produce necrosis and degenerative changes in cells, but rather providing a persistent, mild, irritative stimulus capable of inducing boundless cell-division, therefore probably intra-nuclear and not very abundantly present.

A toxic microbe or one multiplying freely would easily lead to cellular necrosis, caseation or at least marked inflammatory reaction. The former (caseation) is unknown in cancerous growths, the latter very moderate, much of the small round-celled infiltration seen round cancer nodules being probably or possibly due to pressure.

(5) Not easily isolated from cellular elements, either by cultivation, filtration, diffusion, centrifugation, desiccation or any other usual laboratory method. On the other hand very resistant when bound to its cells, because cancer cells will stand freezing with liquid air and yet be transplantable, as repeated experiments with mouse carcinoma have proven.

These properties would produce only a low infectivity, because under ordinary circumstances the wholesale scattering of intact cancer cells does not appear probable. And, as a result, though the accumulation of cancerous disease has been noted in certain households, still the development of the growth has usually taken place at such intervals (but in the same surroundings) that a direct or personal contagion is not easily deducted or proven, for the infection (if any) may equally well be connected with the building and not the individual.

(6) Therefore similar in this, and probably this only, to the germs of actinomycosis and tetanus which are fairly ubiquitous in nature, but yet do not cause disease in man or animals till they obtain not only an entry but special conditions favouring parasitic multiplication.

(7) Unlike tetanus and actinomycosis (and one might add certain leptospiræ) the parasite of cancer need not be ubiquitous in nature in the sense of its "sapropelic" occurrence, for numerous conditions exist in which individuals may harbour a protozoon, protist, mycete or bacterium, all of them closely allied to pathogenic varieties (and in some cases actually indistinguishable from those causing serious diseases) and yet appear in perfect health.

It therefore might be ubiquitous in the sense of being widely distributed not necessarily in the wide wide world, but as occurring in all vertebrates or perhaps being found consorting in different varieties with all forms of life.

These seven points have already been published in the *South African Medical Record* of Capetown (1925), and at the time I stated that one type of micro-organism and one only could comply with these conditions and that a microplasm, following by giving particulars of the appearance of Plimmer's bodies in cancer. The reader who is interested is referred to the paper in question; but as a personal note I may mention that in the course of time the growing conviction that malignancy if not "parasitic" in origin was connected in some fashion with the appearance of certain peculiar definite corpuscles of the nature of Negri's bodies in rabies, made me relinquish medical practice at the end of 1924 to dedicate myself to the experimental proving or disproving the theories I had formed on the subject.

With great interest, therefore, I found that L. W. Sambon had published in this Journal in the issue of February 2, 1925, the following views, the outcome of

numerous epidemiological researches in Romagna and other parts of Italy and Iceland :—

"Whatever be the rôle of parasitic worms, the actual, the essential course of cancer is some ubiquitous micro-organism, probably a filter-passer, as the researches of Rous and his fellow-workers seem to indicate," &c.

It is also known how Sambon gives a lucid and most suggestive explanation for the existence of cancer houses by noting the presence of parasitic helminths in experimental and spontaneous cancers of the stomach of rats, and from this logically deducing that the existence of cancer houses is connected with the presence of certain household arthropods, e.g., cockroaches, meal-beetles and also dung-chafers, capable of fostering and disseminating helminthic parasites such as the young forms of spiruroid worms of the genus *Gongylonema*, in addition to the presence of some ubiquitous micro-organism, possibly ultramicroscopic, which, favoured by the irritative activities of the worm, may invade the tissue cells and give rise to malignant cells.

His views are mainly based on analogical conditions in elephantiasis, on the experiments of Fibiger, Bullock and Curtis, Borrel and others ; the observations of Borrel and also Askanazy and his own personal investigations in Romagna, Trentino and Iceland. To these the name of Galli-Valerio could be added.

It may be mentioned that Sambon is constantly gathering more and more confirmation of his views on the subject by the only method suitable for such epidemiological studies—that is critical, personal observation—either your own or that of competent and reliable investigators.

Before leaving the subject it should be explained that worms of the *Gongylonema* genus, though widely distributed and parasitic in numerous animals, have so far but rarely been described as parasites of man—four cases in the U.S.A. and two in Italy. Still, the worms are minute and transparent, and may be temporary parasites only, that is, do not thrive in human tissues, but die and set up a condition of aseptic irritation prone to produce a precancerous condition fit for the multiplication of a virus.

It may appear that so far Sambon's views on cancer rest on slender grounds, owing to the few cases of *Gongylonema* parasitism in man, but the relations of helminths only a few years ago would have been considered visionary, and yet a study of medical literature shows that since the publication of Askanazy's cases in 1901 numerous instances of concurrent helminthic parasites and neoplasms have been published, though in private conversation a noted scientist objected to the view that helminthic infection could lead to cancer. "If that were so, how is it that no cases of cancer caused by *Trichinella* infections have ever been reported?" As a matter of fact *Trichinella* was first discovered in 1852 in a case of cancer of the penis, and several cases have been published with such a connection—ten all told thus distributed—three lips, four breasts, one each rectum, pleura, penis, and tongue, all cancers, no sarcoma, and in these as in many other conditions the unpublished cases are probably more numerous than the published, though it must be admitted that *Trichinella spiralis* encapsulates in a fashion which gives rise to but little tissue reaction, and its connection with cancer may or may not be fortuitous.

J. Ewing (1922), a stern opponent of the parasitic theory of cancer, states on p. 123 of his "Neoplastic Diseases": "I rather frequently find trichinæ in cancerous tongues."

Accordingly the attention of medical men working in tropical climes should be drawn to the possible development of cancer or sarcoma in individuals harbouring *Filaria medinensis*.

Evidently not all cases of cancer are due to helminthic parasites any more than the development of sweep's-cancer covers the whole problem. Sambon's views are meant to be an explanation of the incidence of cancer in certain houses and districts, and even so they postulate the presence of a virus capable of producing cancer without the aid of helminthic parasites, given other suitable circumstances.

XII.—Rous Fowl Sarcoma and Similar Viruses: Their Relationship to Oncology.

The prolonged and intensive investigation of the Rous fowl sarcoma group of filtrable viruses has resulted in a series of valuable observations which eventually will be useful in guiding the study of analogous neoplasms in mammals. Indeed at the present moment a sarcomatous disease of the mouse is being experimentally investigated by the Imperial Cancer Research Laboratory. The observation that tissues of this sarcoma when kept for ten days in glycerine are still capable of infecting, leads one reasonably to expect the presence of a filter-passing virus.

That viruses may play an important part in the production of malignancy has only just begun to be recognized, and the conclusions of a previous paper in the *South African Medical Record* (December, 1925) are refreshed and fortified by the following recent observations :—

(1) The conclusive transmission of warts and condylomata by filtrates after an incubation of months ; for the resemblance of warts and certain carcinomata has puzzled many investigators.

(2) The analogical observation of the property of certain viruses in causing cell-proliferation (epitheliosis contagiosa, Rous fowl sarcoma, the virus of warts, vaccinia in the rabbit cornea, some herpetic viruses).

(3) The discovery of a mammalian sarcoma due to a filter-passing virus.

It is true that as yet—but only as yet be it noted—tar-carcinomata can solely be transmitted by cell grafts and that filtrates are inert, apparently even if inoculated in a so-called pre-cancerous condition, but against this there are the observations of Alexis Carrel who has found a "filtrable principle" in sarcomata produced originally by diverse irritative agents such as tar, arsenic, and indol in fowls and

experimentally proved that this filtrate will reproduce the neoplasm.

Carrel considers that this "filtrable principle" is not a "virus" and that the sarcoma is to be considered as a general tissue reaction, similar to inflammation and suppuration which can be produced by numerous bacteria and also by chemical agents.

Carrel being a scientist of international reputation, his views must be fully considered before being rejected, but it can well be imagined that here we are dealing with circumstances very similar to those relative to the study of Twort's bacteriolysin, which, as we know, is also very difficult to distinguish clearly from an enzyme with the faculty of multiplying.

This can be explained by a rough comparison: the observation of two buckets being emptied, one containing fine dry sand, the other silt. It would be difficult at a distance to distinguish the liquid and the granular substance by sight, and definite evidence could be obtained only by touch or near examination.

Accordingly when one considers living protoplasm whose size is apparently slightly above that of an albumin molecule it is difficult to make a clear-cut distinction from many other similar substances and one can only take as a guide the sum total of the observations of many different investigators.

It cannot be denied that there exists already a series of experimental results and clinical observations proving that cell proliferation approaching that found in malignant growths can be induced by viruses we know. In addition three common properties of microplasms require special attention in connection with cancer-studies:—

(1) The tendency to multiply and express pathogenic properties in previously irritated surfaces.

(2) Long periods of latency followed by outbursts of virulence.

(3) The possible enhancement of virulence by repeated transference.

The clinical applications of (1) and (2) are self-evident. (3) requires a short explanation.

Experimentally we know that vaccinia or a virus of the herpes group from man can by frequent and repeated inoculations from one rabbit to another be rendered so virulent for the rabbit that whilst initially we required a given quantity to bring about fleeting pathological symptoms, in course of time a hundredth or even a thousandth of the original dose will produce severe lesions. Admittedly one can also enhance the virulence of bacteria for certain animals, but to a much less extent.

Now microplasms are above all obligatary intracellular parasites, and it has struck me that a virus accidentally invading cells and which, owing to regenerative processes, was in a state of fairly frequent division following cellular necrosis and sphacelation, would find itself in similar conditions of frequent transplantation from one cell to another, thus renewing its youth and increasing its virulence, enabling it to invade rapidly a great number of cells.

As a matter of fact, growths of the type of Rous fowl sarcoma and also Jensen mouse cancer are both capable of increasing their virulence in the same fashion. Clinically such an increase is not alway evident, because human cancer is not transplanted but who has not observed the rapid growth after a incomplete operation? It seems to me that th opening up of vessels and lymph spaces does no wholly explain the phenomenon, but that possibl active cellular regeneration is preparing suitable soi for a rapid multiplication of the virus in suitabl epithelial cancer cells.

One can attempt to place the whole matter in nutshell with the following statements:—

(*a*) Human and animal warts have been experi mentally proven to be due to filtrable viruses.

(*b*) In fowls sarcomatous growths, both spontaneous and produced by irritants or due to filtrable virus, have been extensively studied; in the mouse similar spontaneous growths have just been recognized.

(*c*) Helminthic parasites have experimentally given rise to malignant neoplasms in the rat and rabbit In man similar clinically and microscopically accurate observations have been reported.

(*d*) Filtrable viruses (microplasms) show a common tendency to develop their pathogenic properties in definite cells of irritated or injured tissues.

(*e*) The presence of chlamydozoic bodies in human cancer and mouse-tumour either postulates that an innocuous virus is multiplying within their cells, or that these neoplasms are due to a virus. A third alternative, that these bodies are figments or artefacts cannot be as stoutly upheld as it would have been some years ago.

(*f*) Not all viruses can be readily or easily isolated by filtration. In some cases, especially when dealing with viruses which are scantily present in tissues, not every experiment succeeds.

(*g*) The unsuspected ubiquitous presence of viruses of the herpetic type removes a great theoretical difficulty which stood in the way of cancer being considered a parasitic disease, and this for reasons already discussed.

(*h*) Precancerous conditions in the skin, where they can be easily observed, can be multiple, and then the corresponding basal-celled carcinomata can arise from multiple foci, thus pointing to the paramount importance of the irritative factor.

These eight statements are founded on easily ascertainable and repeatedly observed clinical, microscopical and experimental facts—and therefore they may justify the deduction of certain views on the causation of cancer, even though they may appear unfounded or even phantastic to many. The essential point, however, is that they should be correct.

XIII.—Specific Properties of Microplasms and their Classification.

A survey of the literature shows that many filtrable viruses have common features, and are fairly consistent in their pathogenic actions, habitat and general properties; thus sufficient is known to enable one to separate biologically a virus which has been accurately studied from a protozoon or bacterium, though admittedly the group thus formed has certain affinities in

behaviour to spirochætes, but even so clear-cut differences can be made out.

A definition or classification of the genus may appear still premature, for we know that leptospiræ are capable of retaining their pathogenic properties after passing filters, and yet cannot properly belong to the group of micro-organisms which cause foot-and-mouth disease in cattle or mosaic disease in various plants, to mention the two first recognized and investigated. On the other hand recent research renders extremely probable the inclusion among viruses of the bacteriolysin first discovered by Twort in 1915.

As a result we have to exclude micro-organisms which are definitely filtrable (leptospiræ), keep in abeyance others whose filtrability is yet subject to discussion (rickettsia), and then include certain peculiar bodies parasitic in living bacteria, which some competent observers are inclined to consider enzymes, and not particulate micro-organisms.

In addition, and here we are treading where others fear to look, it is well within the realm of possibility that viruses exist very similar in many properties to those known as filter-passers, but which, owing to size and protoplasmic constitution, are incapable of retaining their pathogenic properties in the filtrate. It may be possible in fact to form a small group of such viruses of which some members are filtrable with difficulty, and some not at all, but yet sufficiently related in their actions and reactions to require distinct and separate consideration. Experimental proof of these views is being attempted (December, 1925), but in the meanwhile for the purpose of critical review the viruses have been arranged according to the organisms they invade or consort with, and only those definitely filtrable have been considered.

The general properties of microplasms have been discussed in a previous chapter, in which it was shown that invisible in this instance really meant "microscopically indistinguishable," and that this criterion could not be used, either alone or with that of filtrability, as a distinguishing sign in the classification or diagnosis of viruses, as both are factors of size.

The literary survey has made it evident that neither geographical distribution nor occurrence can be used for the same purpose; because microplasms are known to be independent of clime and longitude and have been so far described as parasites of bacteria, plants and vertebrates, and no doubt the list will soon be extended to other forms of animate Nature.

Bacteria, mycetes, protists and protozoa are identified by their morphology in the first instance, and then by the sum of their behaviour under varying conditions, the majority being observations of artificial cultures *in vitro*.

Both these methods fail us with true microplasms, and therefore we must concentrate on observations based on the effects produced in various cellular elements invaded by the virus.

A virus due to microplasms should therefore be distinguishable by the following actions and reactions.

(I) *Parasitism.*

Obligate and selective parasitism of definite living cellular elements. Can survive over long periods by consorting with similar cells, but does not multiply outside a certain selected cellular host.

(II) *Experimental Transmission.*

Can be transferred till infinite dilutions (10^7 and more) are reached and yet pathogenic effects produced in suitable receptive animals—this in distinction to certain powerful toxins.

(III) *Natural Infection.*

Usually by mediate or immediate contagion. Insect vectors usually purely mechanical.

(IV) *Cultivation in vitro.*

Not artificially cultivable on ordinary or slightly modified bacteriological media. This excludes the virus of pleuro-pneumonia, which has bacterial affinities.

(V) *Isolation by Filtration, &c.*

Intracellular occurrence in certain definite tissues, but can be separated from them without losing pathogenic properties by trituration, centrifuging, diffusion, filtration, maceration, hydrolysis or similar methods.

(VI) *Selective Cytotropismus.*

When inoculated intravenously, intraperitoneally or corneally in a receptive animal will cause alterations in certain tissues only—usually if these are previously irritated (erethismus).

(VII) *Vitality.*

Will resist desiccation (and in some cases also subsequent pulverization of cell-host), mild antiseptics, saponine, easily destroyed by permanganate of potash (oxidation).

(VIII) *Thermic Influences.*

Resist freezing even with liquid air—usually killed or considerably attenuated by heat of or above 55° C. for an hour.

(IX) *Chlamydozoic and Strongyloplastic Bodies.*

Many are apt to cause the appearance of a peculiar intracellular reaction in the shape of oval and round fuchsinophil bodies, which are usually not very sharply defined from the surrounding protoplasm.

(X) *Infectiousness.*

Varies within wide limits, may be limited to one genus or species of plant or vertebrate, or may multiply in several, then as a rule producing in all very similar cellular alteration.

(XI) *Incubation.*

Also variable in vertebrates—some as short as five days, others extending to months (warts = verrucæ).

(XII) *Latency.*

Long periods of latency or cryptic subdued multiplication possible with all viruses which have been studied from this standpoint.

(XIII) *Immunity.*

(*a*) *Passive.*—Lasting in the "pock" group, but variable in others. (*b*) *Active or experimental immunity.*—Obtainable in various fashions and different degrees with all viruses known. (*c*) "*Cross-immunity*" experiments possible for the identification of viruses. (*d*) *Polyvalent and irreversible immunity.*—Observed so far only in vaccinia-variola. Vaccinia immunizes against variola, but variola does not immunize specifically against vaccinia. Vaccinia immunizes also against alastrim (milk-pox) but not vice versa, at least not completely; in fact, extraordinary to relate, vaccinia though a strictly localized condition seems to immunize better against alastrim and small-pox than the viruses of these diseases. (See M. H. Gordon, Special Report No. 98.)

(XIV) *Cellular pathogenicity.*

Three degrees of intensity distinguishable, which may occur singly or be mixed in the same infection.

First degree (subpathogenic). Similar to the irritative action of a finely emulsified foreign body, but continuous; resulting in the extensive proliferation and multiplication of certain definite cell-elements. Examples: Rous fowl sarcoma; verrucæ.

Second degree. Resembles toxic action to a certain extent; the cell is usually eventually killed, but during a certain time limited rarefaction followed by vacuolization are the predominant features, together with perivascular round-celled infiltration.

Third degree—rapid colliquation, necrosis, often with the aid of certain bacteria; example, variola.

(XV) *Toxins.*

Production of toxins in some viruses probable, but in all cases presence or absence difficult to prove for evident reasons.

(XVI) *Virulence.*

This often decreases in the course of transmission from one animal to another, but it can be appreciably increased in various fashions, among the principal being frequent transmission at height of infection and addition of inactivated virus.

(XVII) *Ubiquitous attenuated viruses.*

This heading not sufficiently descriptive, but meant to draw attention to the frequently experimentally proved observation that, analogically to what has been observed with bacteria, concurrently with the epidemic or epizoic spread of an exceedingly pathogenic virus, very similar attenuated strains may be found infesting, more or less harmlessly, the tissues of various animals or individuals; often even after the epidemic or epizoic has died out, the attenuated viruses are still detectable in different individuals—perhaps even permanently.

These characters of microplasmic viruses have been arranged with a view to their distinction from protists or protozoa, bacteria and toxins, all of which under circumstances can cause symptoms easily confused with those due to filtrable viruses; they are also mostly the results of observations made on warm-blooded animals, yet with certain variations they will be found applicable to the virus-diseases of plants and also bacteria.

The list supplies a key to identification which should render recognition possible in suitable instances, and give a basis for a workable classification.

Von Prowazek in 1907 grouped several together as Chlamydozoa (from χλαμυς = mantle), in view of their peculiar property of causing a definite cellular reaction which results in the formation of bodies variously named, such as Guarnieri's (vaccinia), Negri's (rabies), v. Prowazek-Halberstädter (trachoma), molluscum-bodies (discovered by Henderson and Paterson), Borrel's (clavelée, and also fowl-pox), and many others.

Later (1912), von Prowazek divided the Chlamydozoa into three groups, according to whether they consistently attacked the nucleus only, or the protoplasm, and as a third alternative whether they invaded both, and differentiated a further group which he called the Cyto-oikon-group (from οἶκον = house) which caused chronic diseases of the epithelium, not by destroying it, but rather by exciting its proliferative properties.

Lipschütz reviewed the subject in 1913 and some time before, in 1908, had noticed that even smaller bodies than the ordinary Chlamydozoa could be microscopically detected, which through coalescing or aggregating formed Chlamydozoa. These round, minute bodies he called Strongyloplasmata (from στρογγυλο = round), and included among them also the microbe of peri-pneumonia of cattle.

He then published a schema for classification of the filtrable virus, dividing them in two groups: the first comprising acute generalized infectious diseases, this consisting of eighteen viruses among which he placed yellow fever, Rocky Mountain fever, heart-water, virous myxomatosum of rabbits, scarlet fever and measles. This group is at present obsolete for various reasons.

The second group, that of viruses with prevalent localization in definite organs and tissues, is subdivided again into five lesser groups, and as this in the main still holds good, it shall be translated in its entirety.

I.—*Localized epidermal or epithelial.* (1) Molluscum contagiosum, (2) Warts (verrucæ), (3) Trachoma.

II.—*Dermotrope.* (1) Vaccinia-variola, (2) Foot-and-mouth disease, (3) Fowl-pox, (4) Sheep-pox, (5) Stomatitis bovis papulosa specifica, (6) Alastrim.

III.—*Neurotrope.* (1) Rabies, (2) Poliomyelitis, (3) Geese-pox, (4) Guinea-pig paralysis, (5) Distemper, (6) Aujeszky's disease.

IV.—*Hæmotrope.* (1) Fowl leukæmia, (2) Pernicious anæmia of horses.

V.—*Organotrope.* (1) Peri-pneumonia, (2) Agalactia contagiosa, (3) Myxoid disease of rabbits, (4) Epidemic parotitis (mumps).

This includes all diseases which were known at the time to be due to filter-passing viruses and a few which were only suspected as such, and also some which investigation has in the meanwhile shown could and should be arranged in a group by themselves, such as the leptospirosis diseases and those connected with *Rickettsia* bodies.

Even so, the grouping is definitely useful, and one can imagine it will serve as a foundation of an

classifications which will be suggested later as a result of increased knowledge of the subject.

Philibert, 1924, based his classification evidently on that of Lipschütz, but with a certain echo of the opinions of von Prowazek in the cytolytic and cytokinetic groupings induced by the evident affinity or cytotropismus of filter-passers for certain cellular elements.

He divides viruses accordingly into two main groups, and then subdivides them in the following fashion according to their predominant affinity :

(1) *Cytolytic.*

(*a*) Epithelial affinity (epitheliosis). (1) Foot-and-mouth disease ; (2) Variola ; (3) Vaccinia ; (4) Sheep-pox ; (5) Variola des chiens ; (6) Herpes.

(*b*) Nervous system (Neurotropes). (1) Lethargic encephalitis ; (2) Rabies ; (3) Mumps.

(*c*) Endodermic (?). (1) Hog cholera ; (2) Fowl-diphtheria.

(*d*) Mesenchymatous. (1) Pernicious anæmia in horses.

(*e*) Microbes. (1) Bacteriophage (Twort's bacterio-lysin).

(2) *Cytokinetic.*

(*a*) Epithelial. (1) Trachoma; (2) Molluscum contagiosum ; (3) Fowl-pox ; (4) Warts.

(*b*) Mesenchymatous. (1) Fowl-sarcoma.

This is evidently only a tentative sketch, because it separates identical viruses under two headings, leaves out all plant viruses, and does not cover more than a small portion of the known viruses, which now number well over fifty ; if one adds to these the diseases where there are good reasons to believe that they are caused by a filter-passing virus, the number would reach the century. Accordingly in this paper only the principal and best known viruses have been mentioned and they have been arranged according to a definite and conclusive criterion—their occurrence and transmission in nature, a matter about which there can be but little disagreement.

XIV.—Conclusion.

Even these necessarily incomplete notes show the extent and importance of the study of filtrable viruses or microplasms. The ground already covered and definitely secured by experiment and observation would by itself be sufficient to arrest attention ; much greater are the possibilities which we can begin to perceive.

It is usual to include scarlet fever and measles among diseases due to filter-passers, and though single experiments have succeeded and chlamydozoic bodies been described in these diseases, the evidence so far available is not sufficient for clinical application.

Also chicken-pox, herpes zoster, alopecia areata, certain leukæmic types of blood diseases, possess the habitus of infections due to cytotropic cell viruses, because pathological alterations are so strictly limited to one type of cell. Their definite addition to the group, however, must be postponed till more evidence is available, though also here single experiments have been reported showing the possibility of isolating a filtrable virus from some of those diseases.

Proof positive usually fails owing to the fact that human infections with filter-passers are as a rule only experimentally transmissible to human beings, especially if the corresponding clinical symptoms are to be faithfully reproduced.

It may appear that the same could be said of malignant neoplasms, but in this case we are dealing with a big group of viruses, conclusively present and easily isolated in certain animals, and it is only a question of extending the knowledge thus acquired to the more intensive study of cancer in man and animals along certain lines of purposive experimentation.

We are but beginning to obtain a knowledge of these micro-organisms and their properties, and if we but cast our thoughts back in the study of syphilis or tuberculosis during the last fifty years, we can perceive on what lines advance is to be expected. A Frenchman said in the last century that the cause of cancer, syphilis, tuberculosis and original sin was an indissoluble "quadrille", which would defy our efforts to make them dance to a tune of our choosing to the end of time ; witty man, but indifferent scientist.

Molteno Institute of Research in Parasitology.
December 20, 1925.

Syphilitic Pseudo-Elephantiasis. — Dr. H. MacCormac showed, before the Dermatological Section of the Royal Society of Medicine, on June 18, 1925, a case of syphilitic pseudo-elephantiasis in a man, aged 73, who gave the following history : Seven years ago he was suddenly attacked with severe pain in the back, and the left foot, leg and thigh became swollen and œdematous. About three years later what he describes as two ulcers (in reality gummata) developed in the left thigh. A varicose condition then developed over the left abdomen, thigh, scrotum and penis, indicating further obstruction of the deeper veins of the thigh or pelvis. No other symptom occurred until about a year ago, when the elephantiasis lymphatic varices and ulceration developed in the left leg.

On admission to hospital the following condition was observed. Enlarged veins were present in the left abdominal region, thigh and scrotum. Two pigmented scars marked the site of the former gummata; the left foot and leg were swollen, and lymphatic varices in the form of papillomata were present about the ankle. In this area there were two small ulcers. Treatment by rest, bismuth injection and potassium iodide produced considerable improvement.

The exact nature and position of the venous obstruction are difficult to determine. Although the Wassermann reaction was strongly positive, no history of syphilitic infection could be obtained. The history of the sudden pain in the back with swelling of the leg, suggests a thrombosis at that time, but the later and more considerable changes directly followed the gummatous development in the left thigh.

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THE JOURNAL OF

Tropical Medicine and Hygiene

JANUARY 15, 1926.

THE RELATION OF FRAMBŒSIA TO SYPHILIS.

IT has been held by some authorities that frambœsia is to be looked upon as a form of syphilis, and this view has been the subject of discussion ever since the two diseases simultaneously first began to engage the attention of European physicians soon after the discovery of America; and prominent amongst modern syphilographers who have supported this theory stands the name of Sir Jonathan Hutchinson. That the clinical course of frambœsia shows a certain parallelism to that of syphilis would afford some support to this view. Thus, in both affections, after a period of incubation, usually of some weeks' duration, and often characterized by signs of malaise, rheumatoid pains, headache and irregular rise of temperature, the primary lesion appears at the seat of inoculation or infection. This primary stage is followed in both diseases by a secondary stage in which the characteristic eruption occurs, and then by a tertiary or late stage in which the late manifestations of the disease develop, namely, deep ulcerations and gummatous nodules. A fourth period may also be added, named respectively parasyphilis and paraframbœsia. In both diseases alike this division into three or four stages is somewhat arbitrary, as symptoms characteristic of one period may be encountered in another stage. Again, there are a certain number of cases of both diseases showing periods of latency in which the patient is apparently free from symptoms but sooner or later shows renewed manifestations of the infection. In the case of syphilis this latency has often been emphasized in recent years by the findings of the Wassermann reaction.

That frambœsia and syphilis, however, are two different maladies was proved by actual experiment in 1882 by Charlouis. The discovery of the different causal organisms—the *Treponema pallidum* of syphilis by Schaudinn, 1904, and the *Treponema pertenue* of frambœsia by Castellani in 1905—established the modern view of the separate identity of the two diseases. In further support of this view it may be pointed out that in frambœsia the seat of the primary lesion is always extragenital, whilst in syphilis an extragenital primary lesion is so rare as to be almost a pathological curiosity. Many ætiological considerations also point in the same direction. Thus, in frambœsia sex does not exert any influence, nor does age to any great extent, though the disease occurs most frequently in children and young people. Insanitary conditions also to a certain extent favour the development and dissemination of the disease, the malady being rare among Europeans and the better class natives who live amidst good sanitary surroundings, and common among villagers and low-caste natives who live in uncleanly overcrowded huts.

The geographical distribution also differs. Thus, syphilis is world-wide, anl no climate or race is free from it; whilst frambœsia is essentially a tropical disease, few, if any, genuine cases having been reported outside the tropical and subtropical zone, and even in the tropics it is never found in the mountains or in cold districts. Even within the tropics the distribution of frambœsia is patchy. Thus it is extremely frequent in Ceylon, but very rare in India.

The results of inoculation of monkeys have been brought into this discussion. Monkeys have now been successfully inoculated with frambœsia and with syphilis, and many observers have shown that monkeys successfully inoculated with frambœsia do not thereby become immune to syphilis, nor do monkeys successfully inoculated with syphilis become immune to frambœsia, although Levaditi found that the latter animals may acquire a partial immunity to frambœsia. Further, monkeys of the species *Cynomolgus philippensis* are susceptible to frambœsia but not to syphilis.

Inoculation experiments have also been performed in men. Frambœsia may readily be produced in this way, and patients so suffering have been successfully inoculated with syphilis. Nor are frambœsia patients immune against syphilis, as proved by published case reports; and conversely syphilitic patients may contract frambœsia naturally and experimentally. In a recent report, however, Jahnel and Lange (*Münchener medizinische Wochenschrift*, August 28, 1925) tried to infect with the frambœsia spirochætes four persons with general paresis, and failed. They attribute the immunity shown by their cases to the close biological relation which exists between the spirochæte of syphilis and that of frambœsia. This close biological relationship is further shown not only in the close morphological similarity of the two organisms but by the reactions they excite both in the tissues and body fluids of infected persons. The similarity of these tissue reactions places both diseases into the group of the infective granulomata, whilst the similarity in the reactions of the body fluids is shown by a study of the serological reactions. Thus the Wassermann reaction is positive in the great majority of recent cases of frambœsia, though it is frequently negative in old cases. According to Schüffner and Violle, in frambœsia there is often fixation of complement if an alcoholic extract of syphilitic liver is used as antigen, but there is no fixation with an aqueous fixation. Again, the cuti-reaction with "frambœsin," a preparation of *T. pertenue*, is often positive, whilst luetin may also give a positive though less marked reaction. Finally, the action of spirochæticides such as neosalvarsan is rapidly destructive of both organisms, the *T. pertenue* being particularly susceptible.

F. E. T.

Annotations.

Tuberculosis in the Tropics (Sir James Kingston Fowler, *Proceedings of the International Conference on Health Problems in Tropical America*, 1924).—Sir J. K. Fowler points out that tuberculosis may not loom very large in the curricula of schools of tropical medicine, but diseases refuse to be specialized and assert their right to world-wide prevalence, and to this law tuberculosis is no exception. He also considers that the features of tuberculosis as it occurs in the tropics have to do more with the inhabitants, with their past history in relation to it, and with their housing and mode of life, than with the climatic conditions that are peculiar to tropical countries. When tuberculosis is first introduced into a country previously free from it, the natives undoubtedly exhibit a degree of resisting power much inferior to that possessed by inhabitants of countries in which it has been prevalent for generations. It would appear that tuberculosis is on the increase among the native inhabitants of most of the British tropical dependencies. Administrative measures for dealing with tuberculosis, either in the tropics or elsewhere, depend upon accurate diagnosis of the disease, and the only *positive proof* of that disease is the finding of tubercle bacilli.

With regard to notification, Sir James states "whether or not notification of tuberculosis should be enforced must depend, in the tropics, upon the local conditions and upon the degree of civilization to which the people concerned have attained. It is useless if the notifications, as is too often the case, are received only a short time before the death of the patient or after his decease. The value of notification, apart from statistical inquiries, depends on the use that is made of it in dealing with contacts and in removing them from unhealthy surroundings." Further, "My advice to any colony disposed to grapple seriously with the tuberculosis problem," he says, "is to destroy its slums and start a tuberculosis settlement on the lines which I have herein suggested."

Such a Tuberculosis Settlement would comprise: (*a*) ***Diagnosis Ward***, into which all patients should be admitted, and remain until the diagnosis has been settled. (*b*) ***Clinical Ward***, for cases requiring close observation. (*c*) ***Operating Theatre and X-ray Installation***, for the performance of artificial pneumothorax and thoracoscopy. (*d*) ***Sanatorium Block***, for patients going through the usual sanatorium course, but in whom the disease is not yet arrested. (*e*) ***Hospital*** for advanced cases and those who break down when engaged industrially. (*f*) Huts for patients on leaving the sanatorium, as two-bedded, open-air huts are less costly to maintain. (*g*) ***Hostels*** to which patients from the huts may be promoted. (*h*) ***Cottages*** which are reserved for married men. (*i*) ***Workshops***—Training in industries carried on in hygienic workshops involves, in temperate climes, less exposure to climatic conditions which may be harmful, than open-air occupations, but in the tropics such considerations may not apply.

Such a tuberculosis settlement, unlike a colony, within a ring fence forms part of the community as a whole. Main roads may pass through it and its shops are open to all.

"Any country," he concludes, "that rejects compulsory vaccination and retains its slums must pay for small-pox hospitals and tuberculosis settlements. The tuberculosis problem is, to a very large extent, a housing problem in all parts of the

manner. There are normally no distinct pseudopodia. The protoplasmic currents can be seen to flow forward down the middle line of the body, more slowly outward on reaching the anterior end, and gradually backward at the sides. This movement has been well described by Rhumbler in 1912.

It is a characteristic feature that pseudopodia are only extruded apparently under abnormal conditions, as, for instance, when a severe obstacle is encountered, or when the amœba is crushed or placed in saline. Differentiation between the endoplasm and ectoplasm is also characteristically indefinite, but in the above-mentioned abnormal conditions, a clear hyaline layer is sometimes distinguishable as shown in fig. 2. The posterior end of the body, when the amœba is moving forward, is also sometimes quite clear and devoid of inclusions. In the normal state, the relative constancy in shape and simplicity of outline suggest that the body is surrounded by a tough, elastic ectoplasmic covering. The cytoplasm during movement presents a very characteristic appearance of striation, which has been observed by all writers. Janicki's impression was that the protoplasm actually consisted of threads embedded in a more refringent jelly-like mass; Mercier, on the other hand, interprets the appearance as the effect of currents in the protoplasm. This is probably the true explanation, since no trace of them can be seen in resting or stained individuals. Leïdy states that the cytoplasm is ordinarily without inclusions, but these are numerous when the contents of the gut are of a suitable nature for ingestion. Each is usually contained in a food vacuole as shown in fig. 1.

The foregoing account indicates that in movement, and in the differentiation and striation of the cytoplasm, the species *Endamœba blattæ* is clearly to be distinguished from the *E. coli* group. It resembles them in the absence of a contractile vacuole.

The nucleus of the vegetative form is one of the most distinctive features of the species. It is relatively large, oval in shape, and usually measures in length about 15 or 16 microns, and in width 12 or 13 microns, though Janicki describes it as averaging 18-20 microns in width. In the largest individuals it may be 20 microns long. As a rule it has a characteristic shape which may be seen in figs. 1 and 2, where there is a knob-like projection at the pointed end, an appearance that has been noticed by the earlier observers. It may be the result of nuclear division, the knob representing the original point of connection between the two daughter nuclei. This seems all the more probable in view of the fact that the nuclear membrane is remarkable in being at least 1 micron thick. It is homogeneous, but shows a very distinct double contour.

Within the nucleus there is usually found, in the living state, a quantity of highly-refractile granules, occasionally yellowish in colour as noticed by Janicki. These are arranged in the peripheral zone, sometimes regularly, sometimes more to one side so as to form a crescent in section. The central region is quite distinct and has a hyaline or alveolar structure. In stained specimens there is a more or less distinct peripheral zone consisting of granules which stain deeply with iron hæmatoxylin and with eosin. The zone usually occupies the relative amount of space shown in fig. 1, but is often thinner (*vide* fig. 3). In this region there are always a number of much larger darkly-staining masses of various sizes, usually to be found round the inner margin of the zone (*vide* figs. 1 and 2). They may, however, be scattered throughout it, some of them close to the nuclear membrane as shown in fig. 3. On further differentiation these masses (the nucleoli of Mercier) show a granular structure.

In the centre of the nucleus is a clear area which stains very faintly. This is probably what Leïdy meant by the "nucleolus." It shows, as a rule, a hyaline or very finely alveolar structure (fig. 3). The present observations are in accord with those of Mercier in showing that there is no central mass of chromatin, or any body which might be regarded as a karyosome. Janicki (1908) stated that such a body was sometimes to be seen in sections, but as Mercier explained in 1910 this was probably due to an in-pushing of the granular zone. There is occasionally an indefinite, spongy, achromatinic network faintly stained, in the central zone (*vide* fig. 2). The thickness of the membrane, the arrangement of the chromatin, and the absence of a karyosome are all features contrasting this nucleus with that of the *Entamœbæ*.

Among the vegetative amœbæ described above are sometimes found multinucleated free forms which have been overlooked by all writers except Mercier and Janicki. They were interpreted by the former as initial stages in the process of gametogony, which up till now he alone has described. Amœbæ have been found possessing 2, 4, 6, 7, 8, and 10 nuclei respectively (*vide* fig. 4). There can be no doubt that they were free forms, since, though usually rounded in shape, they sometimes showed indications of pseudopodia (fig. 4), definite food vacuoles containing inclusions, and never any trace of a cyst wall. The multinucleated amœbæ average about 30 microns in diameter. The nuclei are different in structure from those of the vegetative form and much smaller. As Janicki observed they are often irregular in shape and of different sizes. The arrangement of the chromatin is extremely variable, probably because the nuclei are generally in different stages of division. Examples are shown in fig. 4.

The normal cysts appear to be of one kind only and not of two ("dark" and "clear") as described by Elmassian. They vary much in size, but are usually under 50 microns, and may be as small as 25 microns in diameter. The number of nuclei is also very variable, cysts being found with only eight and others with over thirty. Fully-developed cysts have probably never less than twenty. The cyst wall is very thick, and shows distinctly in mounted preparations. The nuclei are smaller than those of the multinucleate amœbæ, but are more like them than the resting nucleus of the vegetative form. Each appears, when stained, as a dark irregular

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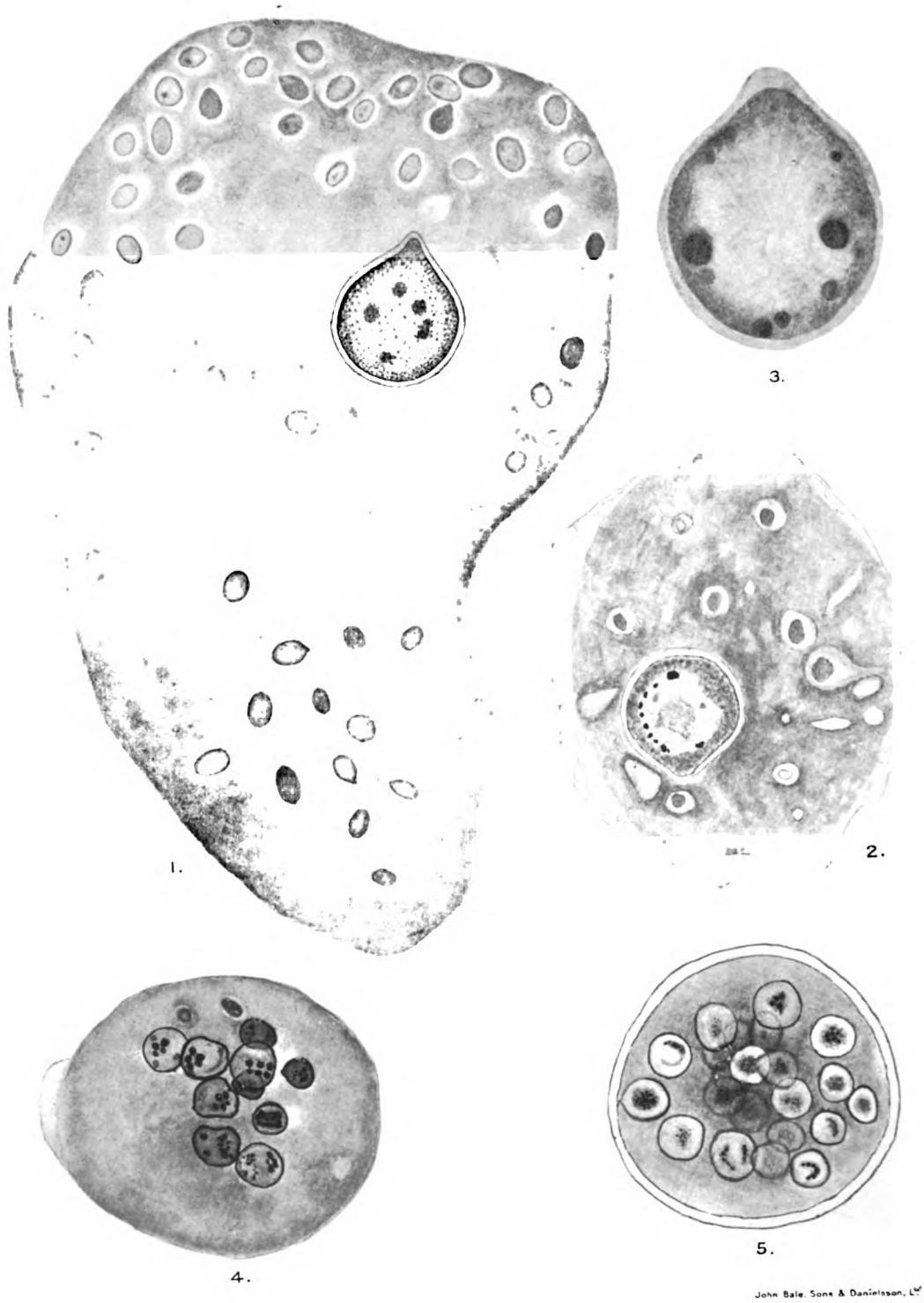
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To illustrate article, "A Preliminary Note on the Study of *Endamœba blattæ*," etc., by J. G. THOMSON, M.A., M.B., Ch.B., and CATHERINE L. T. LUCAS, B.Sc.Lond.

ring within which are a number of deeply-staining granules. These may be scattered, but are often gathered together loosely so as to form a central mass, which might be interpreted as a karyosome (fig. 5.)

Summary.

A restudy of *Endamœba blattæ* (Bütschli) Leidy, 1879, has brought out the following features which distinguish it from *Entamœba coli* Casagrandi and Barbagallo, 1895.

(1) Movement is normally carried out by a steady flow of the endoplasm, and not by means of pseudopodia.

(2) There is a thin, elastic, ectoplasmic layer difficult to see but occasionally modified to form a clear, blunt pseudopodium.

(3) Multinucleated free forms are fairly common.

(4) The nucleus of the vegetative form has the following characteristics: (a) It is large, often lemon-shaped, and bounded by a thick double-contoured nuclear membrane. (*b*) The chromatin is arranged as a broad peripheral zone of granules among which are several denser masses of a granular nature. (c) The central zone is alveolar, and achromatinic. There is no central karyosome.

(4) Multinuclate free forms are often found.

(5) The cysts, which are common, have nuclei varying in number from eight to over thirty.

Conclusion.

The nuclear structure has already been used to classify entozoic amœbæ into different genera, and the constant features of the nucleus of *E. blattæ*, considered together with the characters referred to above, would seem to merit generic distinction on the same principle. Moreover, there can be no doubt that it was only by accident and through lack of co-ordination that certain observers have come to regard the genus *Entamœba* Casagrandi and Barbagallo as identical with *Endamœba* Leidy.

The question which remains to be settled is whether the two generic names, *Endamœba* and *Entamœba* can be retained, as was provisionally suggested by Dobell (1919).

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DESCRIPTION OF PLATE.

Endamœba blattæ (Bütschli) Leidy, fixed in Schaudinn's solution, and stained with Heidenhain's iron hæmatoxylin (figs. 2-5) or Ehrlich's acid hæmatoxylin and eosin (fig. 1). Figs. 1, 2, 4, 5 drawn at a magnification of 1,250 approximately, and fig. 3 at a magnification of 2,400.

(1) Free amœba showing a number of food vacuoles containing inclusions. The nucleus is lemon-shaped and has the characteristic thick membrane. It shows the peripheral zone of chromatin granules on the inner margin of which are lying denser granular masses. The central zone is clear.

(2) A smaller free amœba showing a clear ectoplasm which is not often seen. In the central region is an achromatinic spongy network.

(3) A less typical nucleus than that shown in fig. 1; the granular zone is narrower and the denser bodies are more scattered.

(4) A 10-nucleated free amœba showing a small pseudopodium and two food vacuoles containing inclusions.

(5) A cyst showing the thick wall and twenty-one nuclei, many of which contain a central mass of chromatin granules aggregated in the centre.

A MORPHOLOGICAL AND CULTURAL INVESTIGATION OF *VIBRIOTHRIX ZEYLANICA* CASTELLANI.

By Mario Peruzzi, M.D.
Professor in the Naval Medical School, Naples.

In the autumn of 1923, being in charge of the bacteriological department of the Naval Hospital at Pola, I had the opportunity of carrying out researches on dysentery bacilli found in the hospital cases. The cases were all military men who had never been abroad or in the colonies, neither had any of them previously contracted dysenteric affections.

The bacteriological examination was made according to Castellani's method, which nearly always brought about the isolation of *Bacillus dysenteriæ* Shiga.

In some cases the investigation was rendered very difficult by the presence of numerous colonies of a lactose non-fermenting organism which further investigation proved to be *Vibriothrix zeylanica* (Castellani 1910). Strains of this organism were sent to Professor Aldo Castellani for confirmation of the diagnosis, and he kindly replied that the strains sent to him were identical with his laboratory strains of *V. zeylanica* and with the strain of the Lister Institute.

The principal diagnostic characters of this micro-organism are the following: polymorphic organism, vibrio-like, bacillus-like, spirillum-like, coccus-like, and filamentous forms being also observed; motile, Gram-negative, not acid-fast. No acid fermentation of any sugar; on the contrary there is frequently a production of alkalinity. Milk generally rendered alkaline, at times peptonized.

V. zeylanica was discovered by Castellani in Ceylon in 1904, in dysenteric fæces, and was successively described by the same author under various names (*Spirillum zeylanicum*, *Vibrio zeylanicus*, *Spirobacillus zeylanicus*) on account of its polymorphism. In 1910 Castellani thought fit to create the new genus *Vibriothrix* for this peculiar micro-organism, placing it provisionally with the genera *Leptothrix* and *Cladothrix*, under the Fungi Imperfecti. This name is now generally accepted.

V. zeylanica has also been isolated several times in Europe. It was found in Taranto in 1917 by Castellani himself in collaboration with Spagnuolo and Russo, during their investigations on dysentery in the Navy; they emphasized the point that the colonies of this organism on MacConkey's, Endo's, and other coloured media might be easily mistaken for colonies of true dysentery bacilli. The same micro-organism was isolated in London by Taylor, in 1919, from a patient from Ceylon suffering from chronic dysentery. The isolation of *B. dysenteriæ* Shiga, which had been successful at the beginning of the illness, remained negative, while *V. zeylanica* was found in remarkable numbers.

V. zeylanica was also isolated in Constantinople by Delamare and Alalon, 1922, during researches on refugee Russians from places infected with cholera and dysentery. In an interesting publication in 1923, the authors called attention to the possibility of errors in investigations on carriers of vibrios and in the diagnosis of cholera and intestinal spirochætosis, on account of the vibrio-spirillar form which *V. zeylanica* presents in cultures in peptone-water.

In the same year Jacono reported the isolation of this micro-organism at Naples.

Of the pathogenic action of *V. zeylanica* little has been published. According to Castellani, this micro-organism is not pathogenic *per se*, he considers it to be a nosoparasite. The majority of the strains isolated in Ceylon did not prove pathogenic when inoculated subcutaneously in laboratory animals. The strain isolated in London by Taylor was inoculated without results intraperitoneally in doses of 1 to 2 c.c. in the guinea-pig and rabbit; the strain isolated by Delamare and Alalon was also inoculated without results in doses of 2 c.c. of emulsion from agar culture, subcutaneously and intravenously in the guinea-pig and rabbit, and intramuscularly in the rabbit.

This micro-organism is extremely interesting for its truly singular morphological characters and pleomorphism. Castellani, from the very beginning of his investigation, called attention to the various morphological aspects which the organism may take bacillar, vibrio-like, undulating, spirillar, coccoid and large globular forms, which may be found in the same culture. Taylor, in describing the strain isolated in London, confirmed the characters described by Castellani, and illustrated his work with good photomicrographs of the bacillary and vibrio-spirillar forms.

Anigstein studied a strain of *V. zeylanica* sent by Castellani to the Epidemiologic Institute of Warsaw, and showed with the Zettnow method the presence of very fine cilia in the globular and bacillary forms. When stained with crystal violet and fuchsin he noticed filamentous elements with hyperchromatic segments and alternate clear spaces. In a fresh preparation he also observed the presence of refractive polar granules. Numerous illustrations complete the very interesting paper, showing especially well the situation of the cilia.

Delamare and Alalon, in the two strains isolated at Constantinople, described a more detailed polymorphism, calling special attention to the vibrio, spirochætic, bacillary and filamentous forms of the culture in peptone-water. In their preparations stained with the usual dyes they observed hyperchromatic granules, sometimes situated at one of the poles, sometimes placed in rows. The illustration of the morphological characters is copied from Castellani and Chalmers' "Manual of Tropical Medicine."

The strains isolated by me from cases of dysentery at Pola present all the typical characters of the organism.

(A) Morphological Characters.

Structure of the Micro-organism.—The best method for putting into evidence the peculiar struc-

ural characters of *V. zeylanica* is by staining for 30 to 40 minutes in a 10 per cent. solution of Giemsa. The May-Grünwald method has also given good results. The common, simple stains are less favourable, even if they give on the whole good preparations, especially Roux's gentian violet and carbol-fuchsin. Gram staining is always negative, so is staining for acid-resisting germs, and Neisser's method for spores and metachromatic granules. By using Giemsa staining it is clearly shown that the elements of *V. zeylanica*, whatever their form, attain a very complicated structure; there is a fundamental protoplasm which stains blue, containing chromatic masses of nuclear and chromidial structure which stain purplish-red.

The protoplasm appears homogeneous or slightly granular, at times condensed in masses of lighter and deeper colour. There may be some vacuolization.

Polymorphism.

V. zeylanica is a highly polymorphic organism, but its polymorphism is maintained on definite lines totally different from the irregular degenerative characters so frequent in other bacteria when placed under special biologic conditions. Generally the different forms are found associated, and even in very peculiar conditions of development it is not possible, in my experience, to obtain monomorphic cultures; however, in some cases well-defined elements predominate. The most characteristic forms belong to the following types:—

(1) *Undulating Elements.*—These are characterized by their elongated form and very fine extremities, and by their flexible appearance with two to five large undulations. These are particularly common in broth cultures, and are most evident in the thin pellicle on the surface which often adheres to the wall of the tube. Their dimensions vary exceedingly, from 8 to 15 microns in the smaller forms up to 60 microns in the larger forms. Examined by the hanging drop method, some of them present tortuous movements; some are non-motile. After a few minutes the movements become weaker and cease definitely after about thirty minutes. In stained preparations elements are seen which look very much like protozoa, with their very fine ends and evidence of a nuclear structure, which is generally represented by an elongated, oval mass, staining very deeply, situated in the middle part of the micro-organism. This form, represented in fig. 1, can be considered as typical and completely developed. In certain very frequent forms the protoplasm appears homogeneous, uniform, almost refractory to staining, and contains, besides the central nucleus, numerous spherical bodies possessing the same chromophilic properties as the nucleus (see fig. 2).

Some elements show special particularities which clearly correspond to the various phases of a process of fission. In the phase of preparation, the micro-organism appears larger on account of thickening and contraction of the central protoplasmic matter, which seems to dilate into a bottle shape while the undulations become scarce and less accentuated (see figs. 3 and 4). At the culmination of fission more visible changes take place in the nuclear apparatus, which lead to the separation of two roundish, equal, clearly limited masses (see fig. 5). In the successive phases elements are observed in couples, united by a thin protoplasmic bridge, sometimes hardly perceptible, which keeps together the extremities always occupied by the nuclei resulting from fission (see figs. 3 and 6).

In the hyaline forms the nucleus does not divide into equal parts, but small round bodies originate from each pole, which separate and remain fairly regularly distanced in rows. At the next protoplasmic fission small segments are freed, with nucleated ends, which are probably destined to ulterior development.

(2) *Vibrio-Spirillar Elements.*—These are characterized by their vibrio or spirillar appearance, possessing a certain number of curves. The dimensions vary greatly even in the same culture: from minute, short forms to forms of a considerable length similar to large spirilla. The vibrio forms predominate as a rule in cultures on glucose agar, and also in the first hours of development in broth and other liquid media. The larger and longer forms are observed in the pellicles in broth-blood-media, in condensation fluid, in glucose-blood-agar, and in coagulated blood-serum. The smaller forms are extremely motile; the larger ones move slower and sometimes only show a little oscillation. The smaller vibrioid elements are motile even at room temperature, and in this respect resemble cholera vibrios, although, generally, the curving is less pronounced and the motility less rapid.

The spirillar forms are sometimes present, especially in certain liquid media, only in the first hours of incubation.

Long threads with numerous coils and easily separated in vibrioid elements are observed after three to five hours in blood-broth and in the condensation fluid of tubes of glucose-blood-agar. The chromatic differentiation by Giemsa stain gives them a striped appearance on account of the presence of numerous nuclear bodies of lenticular shape (see fig. 10).

It is interesting to observe the spirillar forms in slant coagulated blood-serum on the fifth to seventh day of development. The younger threads present five to seven coils and can still be seen united in chains (see fig. 11); those more developed look like larger spirillaceæ with fifty or more close, even coils.

(3) *Filamentous and Branched Elements.*—These are characterized by their remarkable length and their filiform appearance with masses of condensed protoplasm deeply stainable, and in parts apparent vacuolation. The chromophilic substance of the nuclear apparatus is found in spherical and cylindrical formations. Sometimes the threads are very long, with a mycelial appearance which singularly recalls that of some nocardiaceæ. Pseudo-ramifica-

tions of the cladothrix type are very frequent, but true **V** and **T** ramifications are also present.

Besides these scarcely clear, branched forms, I have been able specially to observe other more characteristic forms, but not exclusively, in pellicles on certain fluid media. These look so typical and constant that they could be considered as specific manifestations. In their definite aspect they always present a tripod formation, rigorously geometrical, the three parts being at equal angles of 120°. Often such formations have a star-like appearance.

The examination of hanging drop preparations shows the filamentous forms to have a mycelial appearance, without definite movements.

(4) *Claviform Elements.*—These are characterized by their swollen, claviform ends, pyriform or decidedly spherical, varying in size, attaining or surpassing the diameter of 3 to 4 microns. They are frequently found in the pellicles present in fluid media; the clubs become very easily separated from the filaments. In fact, by hanging drop examination and by stained preparations, it is seen how these swollen formations generally detach themselves and complete their evolution as free bodies.

Lateral conidium-like formations are also seen, sessile or sustained by short threads. At times they appear very numerous in cultures in which on the preceding day they were almost absent (see fig. 19).

All the morphological gradations are noted, from simple club thickenings to pyriform or decidedly spherical formations. The younger forms are deeply stained in azure by the Giemsa method; those more developed stain weakly and present small, roundish bodies isolated or flattened, which are stained red-purple by the same method; many of them are very near the periphery and extend to the external surface of the clubs; often small vacuolar spaces are seen in their stead which make one believe there has been an expulsion of chromatic bodies (see fig. 22).

(5) *Globular Elements.*—In all the cultures more or less numerous globular elements are detected. In some cases their numbers are very great in the pellicle formed on liquid media containing blood, and it is easily demonstrated that they were originally terminal or lateral formations of elements more or less elongated, sometimes very small (see figs. 25, 30). Some are very small and have a coccoid appearance, they are uniformly and deeply stained and very likely represent the first phase in the evolution of the spherical bodies; others are larger, attaining a diameter of 1·5 to 2 microns and showing a structure differentiated by the separation of a fundamental substance and of voluminous roundish nuclear bodies, in the shape of a horse-shoe, in wreath-form, &c.; and sometimes they even look like small blastomycetes (see figs. 25, 26).

The larger forms can attain or surpass a diameter of 3 microns.

Cultural and Biological Characters.

Cultural Properties.—As already stated, the organism grows well on all the usual laboratory media; the colonies are generally more or less transparent, nearly always round and only slightly elevated. On potato a reddish or brownish pigmentation is often present and this is noted also on gelatine after three to four weeks. A very rapid and abundant growth takes place on glucose agar mixed with 25 to 30 per cent. of human blood. In twenty-four hours there is a beautiful whitish growth, very rich, slightly viscous, with pellicle and abundant deposit in the condensation fluid. Good growth is also obtained in simple broth or glucose broth with 25 to 30 per cent. of defibrinated blood; in twenty-four hours the formation of a surface pellicle is constantly observed, which easily breaks and sinks to the bottom.

The polymorphism of *V. zeylanica* is not equally manifested in all culture-media; some forms are present almost exclusively on certain media. The undulating forms are found particularly on the pellicle which adheres to the wall of the broth tubes.

Vibrio-like forms greatly predominate in the first hours of culture on fluid media; also in glucose blood-agar. Spirillar elements are very numerous in the pellicle found in the condensation fluid of glucose-blood-agar, and in broth-blood. The spirochætic forms are very numerous in slant cultures with coagulated human blood-serum, after five to seven days' incubation. The filamentous forms are found particularly in the pellicle in ordinary broth.

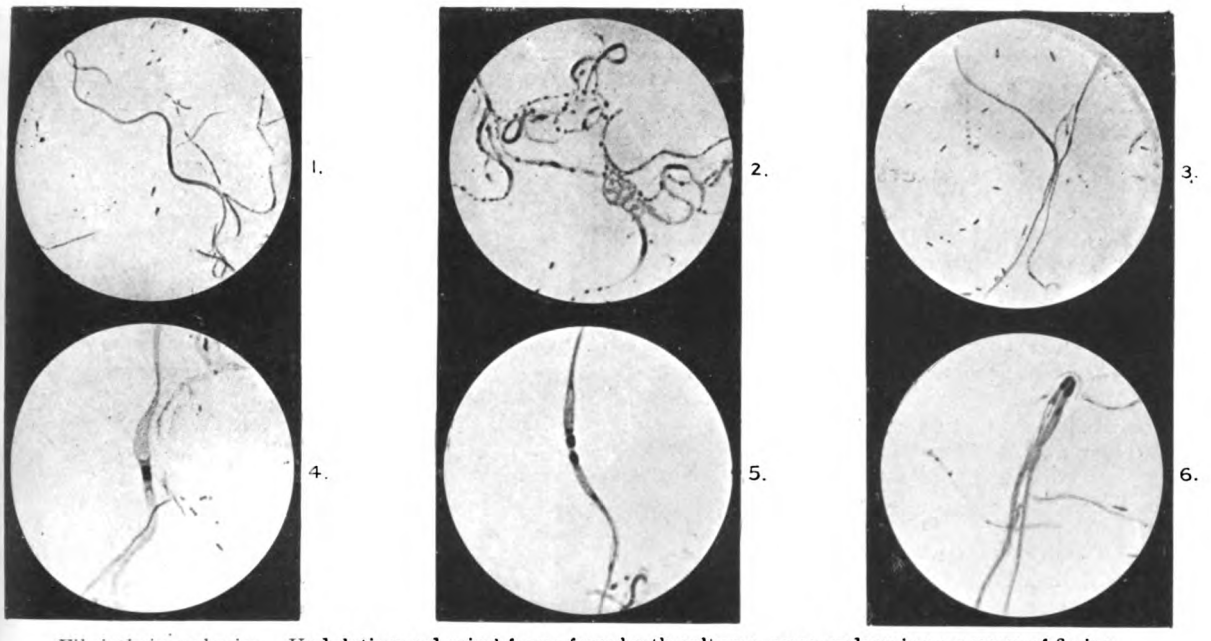
With a view to seeing what form *V. zeylanica* assumes in the intestinal content, I prepared a fæcal emulsion in physiological salt solution which I sterilized at 70° one hour for seven consecutive days. I then added to some tubes 10 to 20 per cent. of heated human serum and inoculated the tubes with *V. zeylanica*. The examination by hanging drop after twenty-four hours' incubation showed elements of *V. zeylanica*, characterized by their special motility and by diverse forms, especially vibrio-spirillar. Inoculating simple emulsions of fæcal matter without the addition of serum with *V. zeylanica* positive results were obtained, but the growth was even and only spirillar forms were observed. The vitality of the *V. zeylanica* culture is remarkable. Ordinary cultures remain alive for more than a year.

Filtrability.

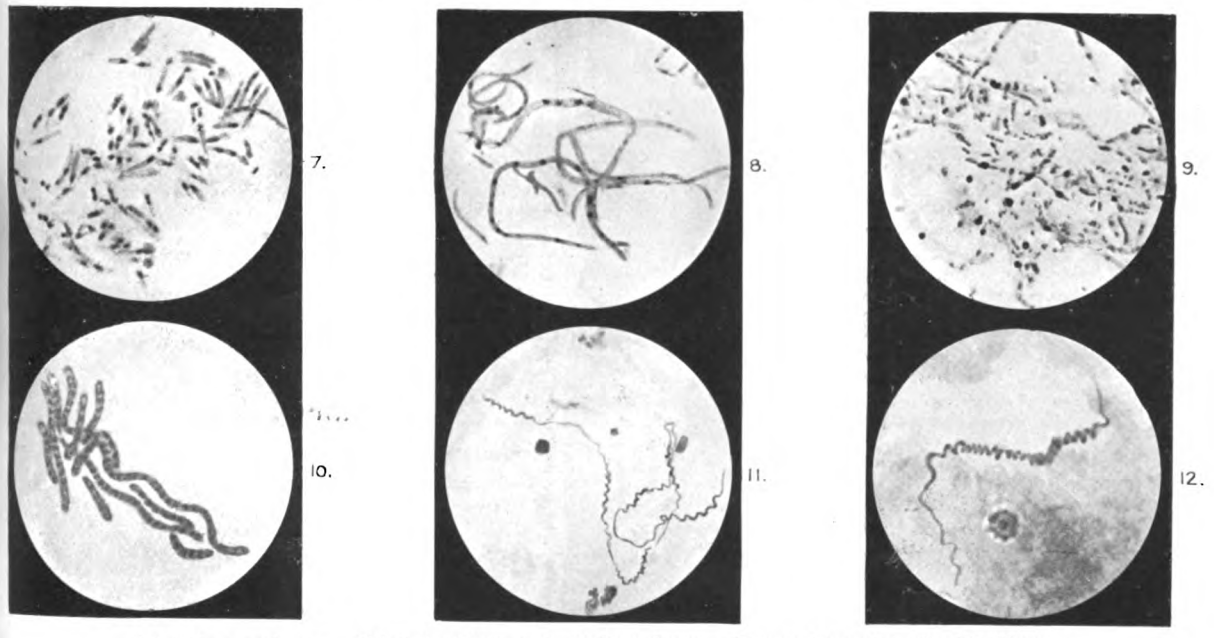
The experiments were carried out using Normayer and Berkefeld N. candles. The filtration was prolonged for ten minutes to an hour. As control micro-organisms, *Micrococcus melitensis* and *Bacillus coli* were used.

The results were always negative when cultures in ordinary broth were used, but when blood-broth cultures were used then a certain number of positive results were obtained; this would suggest that in blood-broth the organism may produce minute spores capable of passing through a filter.

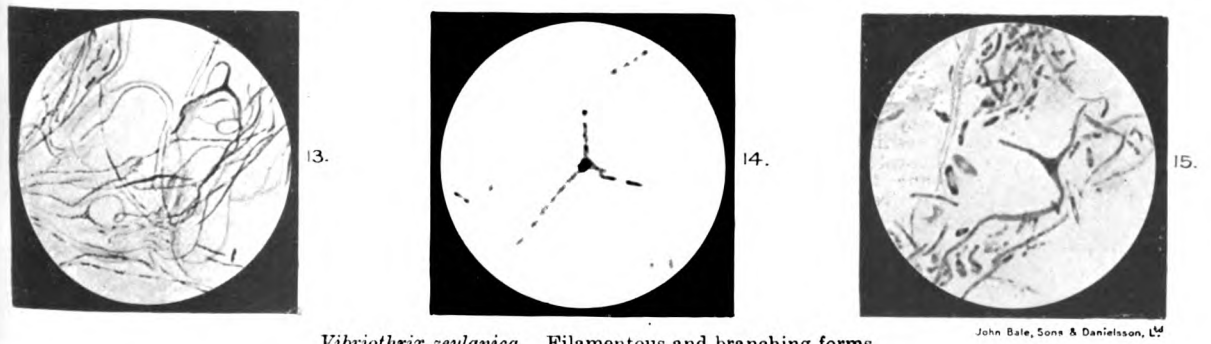
Pathogenic and Antigenic Action.—For these researches I used guinea-pigs about 350 grm. in weight. Intraperitoneal inoculations of a forty-eight hours' culture at 37° C. on slant glucose blood-agar were carried out. The results obtained so far are as follows:—



Vibriothrix zeylanica. Undulating and spiral forms from broth cultures, some undergoing a process of fission.



Vibriothrix zeylanica. Vibrio-bacillary and spirillum forms. Preparations stained with Giemsa.



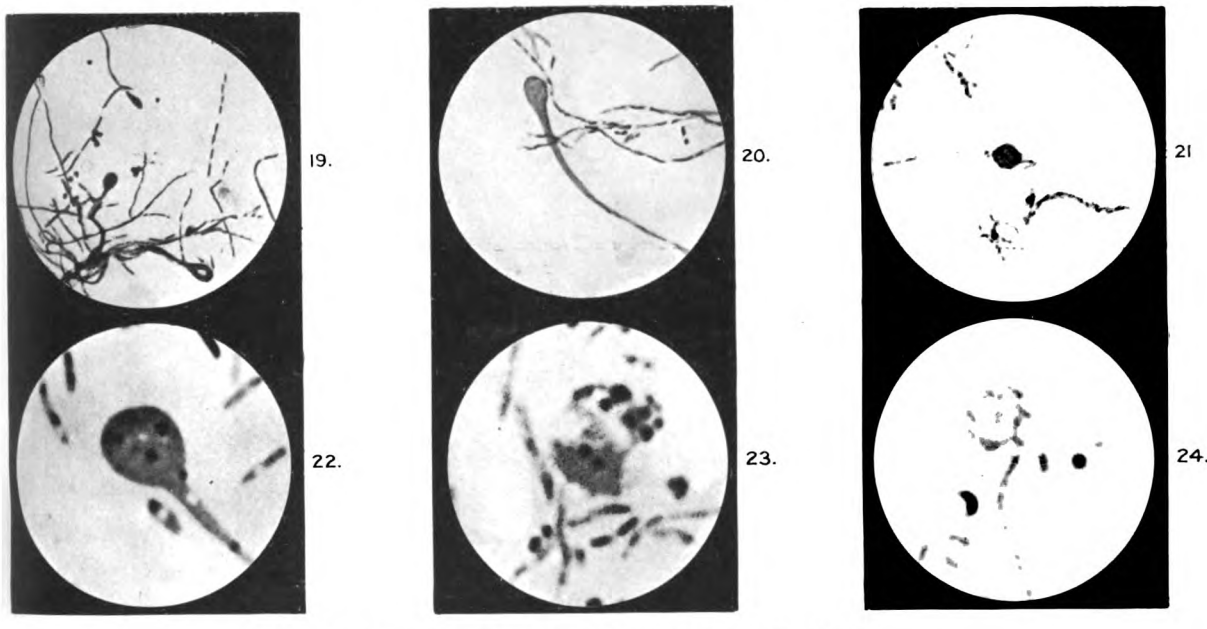
Vibriothrix zeylanica. Filamentous and branching forms.

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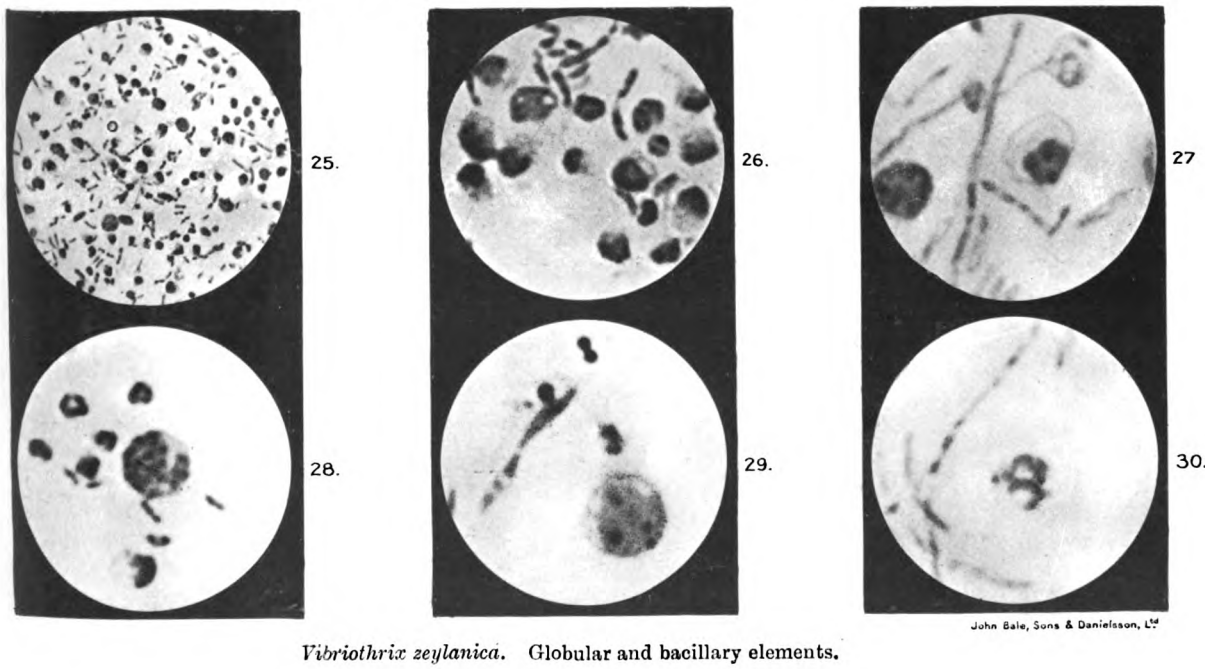
To illustrate article, "A Morphological and Cultural Investigation of *Vibriothrix zeylanica* Castellani," by MARIO PERUZZI, M.D.



Vibriothrix zeylanica. Filamentous and branching forms.



Vibriothrix zeylanica. Claviform elements and spore-like bodies.



Vibriothrix zeylanica. Globular and bacillary elements.

To illustrate article, "A Morphological and Cultural Investigation of *Vibriothrix zeylanica* Castellani," by MARIO PERUZZI, M.D.

The inoculation of one and a half to two surface growths causes death in thirty hours after a long period of coma. Inoculation of one half to one surface growth is tolerated, and produces transitory troubles with notable loss in weight in the first three to four days. Specific antibodies are already in evidence ten days after the first inoculation by means of the reaction of the Pfeiffer, Bordet-Gengou and agglutination tests in dilution up to 1 : 200; after a second inoculation there are immunity reactions, more marked, with agglutination up to 1 : 500. When *V. zeylanica* is inoculated in the peritoneum in moderate doses it is rapidly destroyed by phagocytosis; in animals previously inoculated a ready lytic destruction is also observed.

The anatomo-pathologic changes in evidence at autopsy are characterized by an intense, acute peritonitis, with abundant thick, fluid exudate and fibrino-purulent stratifications on the abdominal viscera.

In the other visceral organs congestive changes are found; some subpleural minute hæmorrhages and pulmonary œdema are present, which should be considered as terminal phenomena in relation with the long period of the comatose state which precedes death.

Conclusions.—A strain of *Vibriothrix zeylanica* (Castellani) was isolated in the autumn of 1923 at Pola from soldiers affected with bacillary dysentery.

Staining with Giemsa's method puts in evidence the complex structure of this micro-organism and shows the presence of a nuclear apparatus highly differentiated, which plays a rôle in the phenomena of reproduction.

V. zeylanica is an extremely polymorphic organism with vibrio-like, bacillus-like, spirillum-like, coccus-like and filamentous and large globose forms. The cultures obtained in broth-blood are filtrable through Berkefeld N. candles.

The intraperitoneal injection of massive doses causes death in guinea-pigs, while the injection of ordinary doses does not cause death and the organism is destroyed by a process of leucocytosis.

With regard to the classification of the organism the presence of branching filaments and sporiform bodies is in favour of the organism belonging to the Fungi Imperfecti; the rapid growth, the presence in certain media of only bacillary and vibrioforms, its antigenic and immunizing action might be reasons to place it among the Bacteria; the spirochætic elements and the well-marked morphological and chromatic differentiation of the nuclear apparatus are suggestive of protozoal forms.

Owing to these various morphological characters the systematic position of this micro-organism could not be better defined than by the new genus *Vibriothrix* created by Castellani.

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A BRIEF NOTE ON THE BIOCHEMICAL REACTIONS OF CERTAIN FUNGI, VIZ., *MONILIA KRUSEI*, *M. MACEDONIENSIS*, and *M. TROPICALIS*.

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IT has been stated by certain authorities that the monilias have no permanent biochemical characters. I thought it might be of interest, therefore, to make an independent investigation into those of certain species of monilia the strains of which have been subcultured for quite a number of years.

The monilias I have investigated are the following: *Monilia krusei*, *M. macedoniensis*, *M. tropicalis*. These were isolated in Ceylon in the year 1910.

Besides litmus milk and gelatine, I passed the strains through the following sugars, namely, glucose, lævulose, maltose, galactose, saccharose, lactose, mannite, glycerine, inulin, dulcite, isodulcite, inosite, adonite, arabinose, amygdalin, salicine, sorbite, raffinose, dextrin, erythrite.

As regards litmus milk, the only change produced was a little acidity by *M. macedoniensis* after some days. No clot was formed by any of the monilia used.

There was no liquefaction of the gelatine in a single instance. The reactions in the sugars are shown below. No reactions other than those indicated occurred in any other of the sugar media, with the exception that *M. macedoniensis* produced slight acidity in raffinose without any gas formation.

The production of gas was constant, and the selection of certain media in this respect by the different fungi makes their differentiation in this way easy and accurate.

	M. krusei	*M. macedoniensis*	*M. tropicalis*
Glucose	AG	AG	AG
Lævulose	AG	AG	AG
Maltose	—	—	AG
Galactose	—	AG	AG
Saccharose	—	AG	AG
Lactose	—	—	—
Mannite	—	—	—
Glycerine	—	—	—
Inulin	—	AG	—
Dulcite	—	—	—
Isodulcite	—	—	—
Inosite	—	—	—
Adonite	—	—	—
Arabinose	—	—	—
Amygdalin	—	—	—
Salicine	—	—	—
Sorbite	—	—	—
Raffinose	—	—	—
Dextrin	—	—	—
Erythrite	—	—	—

In each case the reactions appeared in 24 hours and was markedly definite in 48 hours. The reaction in inulin, however, which was produced by *M. macedoniensis*, did not appear before the lapse of 72 hours and so also those in maltose and galactose by *M. tropicalis*.

The most interesting fact that has emerged from this research is that, although through all these years the growths have been kept renewed by subcultures, they have retained their original characters and have in no way deteriorated, while the results speak for themselves of the absolute dissimilarity in the reactions obtained.

I may mention that the biochemical characters revealed by my investigation are identical with those described by Castellani.

My best thanks are due to the Director of Tropical Diseases of the Ross Institute for permission to publish these notes.

FURTHER REPORT ON ACQUIRED IMMUNITY TO MALARIAL INOCULATION.

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AND
John P. Steel, M.B., Ch.B.Edin.
Assistant Medical Officer to the Hospital.

In the *Journal of Tropical Medicine* for December 1 last we reported 15 cases of general paralytics who showed a definite resistance to reinoculation with malarial blood, and mentioned that we had not had an opportunity of testing their resistance to inoculation by the bites of infected mosquitoes.

Since that date Colonel S. P. James, of the Ministry of Health, has been kind enough to help us in that matter. On November 21, 1925, three cases, which had previously proved refractory to repeated inoculations with malarial blood, were bitten by infected mosquitoes. The following is a brief summary of the results and of the previous inoculation history:—

Case 43.—Inoculated intravenously 27/7/24. Nine rigors resulted, terminated by quinine. Subsequently had relapses of malaria.

Unsuccessfully reinoculated:—

I.M.	...	..	February 11, 1925
I.V. ...	...	...	May 30, 1925
I.V. ...	...	...	July 27, 1925
I.M. ...	...	...	August 5, 1925.

Was subjected to mosquito infection on 21/11/25, and after 21 days' incubation period he developed true malarial pyrexia, with parasites in the peripheral blood.

He had six rigors, occurring daily, and terminating spontaneously, the blood becoming negative to the microscope before the exhibition of quinine.

Case 62.—Inoculated intravenously 29/4/24. Ten rigors resulted, terminated by quinine. No subsequent relapses.

Unsuccessfully reinoculated:—

I.M.	...	...	August 5, 1925
I.M.	...	...	August 31, 1925

Was subjected to mosquito infection on 21/11/25, and after 18 days' incubation period he developed true malarial pyrexia with parasites in the peripheral blood.

He had five rigors, occurring daily, and terminating spontaneously, the blood becoming negative to the microscope before the exhibition of quinine.

Case 51.—This case was treated by mosquito infection before admission to this hospital, and had a number of malarial rigors, details of which are unknown, although he acted as donor of infected blood to many other hospitals.

Unsuccessfully reinoculated:—

Mosquito	...	...	January 7, 1924
I.M.	...	...	April 30, 1925
I.V. ...	...	...	July 17, 1925

Was subjected to mosquito infection on 21/11/25. No pyrexia developed, but on several occasions from the 23rd to the 31st day after infection malaria parasites were found to be present very scantily in his blood.

The last case, No. 51, presents features of interest as he was successfully infected by mosquitoes originally. Since then he has been subjected to malarial infection by all three usual routes and has not shown pyrexia. Blood examinations have been made daily since December 1, and the results have been:—

December 1 to 13	...	...	Negative
December 14	...	...	One parasite found
December 15	...	...	One parasite found
December 16 to 19	...	...	Negative
December 20	...	...	One parasite found
December 21	...	...	Negative
December 22	...	...	One parasite found
December 23 to January 13	...		Negative

No constitutional symptoms of malaria have been observed, and since December 22, despite injections of adrenalin and milk, the patient has shown a consistently negative blood-picture.

In reporting these three cases, two of which have been successfully treated by mosquito infection after being resistant to inoculation with a known old-standing strain which had been eminently satisfactory to us for primary infection, we would like to mention three other cases.

Case 8.—This patient was resistant to reinoculation from our own strain on 27/7/25, but on 17/12/25 he was inoculated intravenously from case 62 (quoted above), who was rigoring as the result of direct mosquito infection. He had five rigors, occurring daily, after an incubation of ten days. His fever ceased spontaneously.

Case 40.—This patient was subject to reinoculations from our own strains on 17/7/25, and again on 6/12/25, but on 29/12/25 he was inoculated intravenously from case 8 (quoted above). After an incubation period of ten days he developed true malarial pyrexia, and is at present having rigors daily.

Case 79.—This patient was resistant to reinoculations from our own strains on 11/2/25, and again on 6/12/25, but on 29/12/25 he was inoculated intravenously from case 8 (quoted above). After an incubation period of ten days he developed true malarial pyrexia, and is at present having rigors daily.

It is possibly worthy of note that each of the successful cases mentioned, two from direct mosquito infection, one from the same strain but with one intervening host, and two after two intervening hosts, have in common the facts that they have been successful after prolonged resistance, and that daily rigors have occurred; in the three cases in which the malaria has terminated, a spontaneous disappearance of the parasites was observed.

We have again to thank our Medical Superintendent for permission to publish Hospital cases, and to Colonel S. P. James we owe a debt of gratitude for his help.

The Value of Iron in Anæmia. An Experimental Study (Charles Spencer Williams, M.D., and Harold N. Ets, *Archives of Internal Medicine*, September 15, 1925).—Inorganic iron, whether given by mouth, subcutaneously, or intravenously, is absorbed and may be found especially in the liver and spleen, but it is not converted into hæmoglobin. Animals made anæmic by one or several large bleedings do not recover any more rapidly when inorganic iron is given in any of these ways. The efficiency of food iron is very pronounced and animals on a diet containing food iron only, recover very rapidly from hæmorrhages that remove an amount of iron greater than exists in the entire body outside the food. In the light of the experiments reported the administration of inorganic iron has no therapeutic value in anæmia.

Treatment of Malarial Fever (Major Alexander T. Cooper, *The Military Surgeon*, October, 1925).—Of the malarial fever cases occurring at Fort Benning during the past three years 90 per cent. were of the tertian type; 10 per cent. estivo-autumnal type, 11·6 per cent. of the tertian cases probably relapsed in from two months to one year. In at least half of these relapse cases the probability of a reinfection can be reasonably ruled out, as the relapse occurred during the winter months. Thirteen patients with tertian malaria received the Army routine plus treatment with injections of arsphenamine. One relapsed. Three cases relapsed who had, in addition to receiving the Army routine treatment, also received an additional one month's quinine medication. Forty-three per cent. of tertian cases gave a history of previous attacks of malaria; 68 per cent. of these stated that they had received previous quinine medication; 44 per cent. of tertian cases showed gametes in their blood. Two out of 10, or 20 per cent., of estivo-autumnal infections relapsed.

Notices.

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THE JOURNAL OF

Tropical Medicine and Hygiene

FEBRUARY 1, 1926.

GIARDIASIS.[1]

NOTWITHSTANDING many recent contributions on this subject, there still exists a considerable amount of doubt as to the degree of pathogenicity, if any, attributable to *Giardia intestinalis*. This organism, discovered in 1859 by Lambl, often bears his name, and is considered by many to be a harmless intestinal parasite, though recent investigation indicates that it may manifest real pathogenicity. Many cases of an explosive diarrhœa were met with during the war in France and in the East in which no other cause than the presence of large numbers of active *Giardia intestinalis* could be found in the stools. It would thus appear that this organism, when present in large numbers in

[1] Lyon and Swalm: "Giardiasis: Its Frequency, Recognition, Treatment and Certain Clinical Factors," *Amer. Journ. of the Med. Sciences*, September, 1925.

the small intestine, can give rise to diarrhœa with bile-stained mucus. The patients are never acutely ill, complaining only of a feeling of abdominal discomfort in addition to the diarrhœa. There is no tenesmus, and the stools are generally fæcal and bile-stained, and contain flakes of mucus. Microscopically large numbers of active *Giardia* can be seen, sometimes along with scanty numbers of red blood-cells. These clinical and microscopic findings readily serve to distinguish this condition from bacillary dysentery.

Until recently giardiasis has usually been considered a parasitic infestation of tropical and sub-tropical regions only. More recent work, however, indicates its greatly increased prevalence in temperate climates.

Since the inception and wider application of duodenobiliary drainage as a diagnostic procedure, the incidence of recovery of the living vegetative forms has greatly increased, and the condition has thereby become correspondingly more frequently recognized, especially in temperate climates. Obviously this manifestation in temperate climates is a matter of considerable importance.

As regards the mode of dissemination of giardiasis there is much evidence that transmission is chiefly by the cysts of the parasite. These cysts are very resistant and may be eliminated for years by individuals who are quite free from symptoms and apparently cured. Grassi successfully inoculated himself by ingesting the cysts. As in typhoid, so in giardiasis, fungus, food and flies are the chief offenders. Various rodents have been suspected of spreading the disease, but no evidence has yet been produced to show that human infestation is referable to them. Air-borne dust containing cysts may settle on and contaminate foodstuffs, and thus serve as a means of dissemination. Lyon and Swalm consider that the likelihood of such methods of transmission is suggested by the fact that, in children particularly, several members of the family may become simultaneously infected. They also consider that it is possible that by air-borne routes the respiratory tract may be invaded, for *Giardia* cysts have been found in bronchiectatic secretions, and they report that three cases of Bartle's all had chronic bronchitis. The great increase in this infection noted during the world war among returning troops also leads them to the belief that direct contact with dejecta and generally unhygienic living conditions tend to spread the disease.

Lyon and Swalm also insist on the frequent clinical association in the adult of giardiasis with diseases of the gall and bladder, bile-ducts and duodenum. It is usually resistant to all forms of treatment, and it would appear that as yet no specific treatment has been developed. Owing to the frequency of relapses being observed, caution should be exercised in prematurely claiming an actual cure in giardiasis.

F. E. T.

Annotations.

Experimental Studies with a Spiral Organism found in a Wild Rat and identical with the Organism causing Rat-bite Fever (H. Mooser, M.D., *Journal of Experimental Medicine*, October 1, 1925).—The spiral organism isolated from a wild rat has proved identical with that from a human case of rat-bite fever in Mexico City. Rabbits can easily be infected with these organisms. The subcutaneous inoculation of them is followed after three to five days by a local œdema, induration and inflammation as a primary lesion. About eight days after the appearance of the primary lesion, œdematous swellings and inflammation appear on the head and genitals as secondary lesions. The organism can be transmitted from rabbit to rabbit by coitus. Protective antibodies are to be found in the blood of infected rabbits at a time when the local lesions are still active. The peculiar character of certain of the lesions is probably due to the escape of the antibodies from the blood-stream. The organism belongs to the genus *Treponema*.

A Group of Micro-organisms Transmitted Hereditarily in Ticks and Apparently Unassociated with Disease (E. V. Cowdry, *Journal of Experimental Medicine*, June 1, 1925).—Pleomorphic, bacterium-like, Gram-negative, intracellular micro-organisms which stained much less intensely with ordinary dyes than most bacteria, were found in sixteen species of ticks comprising examples of the Argasidæ and the Ixodidæ. In six of these species studied intensively slight differences in the micro-organisms were detected, sufficient to permit identification of the vectors by microscopic examination of the micro-organism alone. No evidence was seen of injury to the tissues of the arachnid hosts of the micro-organisms other than that incidental to mechanical distension of the cells containing them. The detection of the micro-organisms in the eggs of ten species, in the unfed larvæ of eight species, and at nearly related stages throughout the life cycle of three others, leads to the conclusion that they are transmitted hereditarily.

Current Literature.

THE KENYA MEDICAL JOURNAL.

November-December, 1925. Vol. 2, Nos. 8 and 9.

Venereal Diseases Measures in Uganda (G. J. Keane).—In order to control venereal diseases and the high infantile mortality rate in the native population of Uganda Protectorate, salvarsan substitutes are issued free to native patients who cannot afford to pay for treatment. For the guidance of medical officers and assistants there is a standard course of treatment. Although the cost of drugs is not small the greater expense lies in the arrangements of distribution of the drugs, such as hospital staff, general

equipment, and attendance of the sick. The best policy for securing attendance for treatment and for maintaining re-attendances is based upon the following considerations: (*a*) Sympathetic handling of patients, particularly by medical officers able to speak to them in their own language; (*b*) offering highly efficient treatment in as painless a form as possible; (*c*) offering well-equipped and well-organized in-patient accommodation for such patients as require it; (*d*) combination of venereal diseases treatment with that for general diseases, and avoidance of special venereal diseases hospitals.

The Natural Enemies of Rats: Their Possibilities in Plague Prevention (G. H. Goldfinch).—The natural enemies of the rat include mammals, birds, reptiles, and at least one insect. The most important of the mammals are jackals, tenneck foxes, serval cats, wild cats, genets, civets, and the mongoose family. The birds are secretary birds, giant hornbills, hawks and owls. The most important insect is the Siafu ant. These animals should be protected and even increased, as the harm they do is insignificant compared with the danger of rats as carriers of plague. Natives rarely, if ever, kill anything that does not actually interfere with themselves or their stock, but in the European areas there is an increasing number of ignorant people who will kill or shoot anything they see simply because it is there. Another important factor is the use of poison for the destruction of the larger carnivora, which causes the death of natives and the wholesale destruction of vultures. The poisoned bait should be put out at night and taken up in the morning. Another point for consideration is the importation of small carnivora from elsewhere, and the most suitable for this purpose are the Indian mongoose and the little owl.

Some Observations of Pellagra in Nyasaland (H. J. Shelley).—Pellagra was first recognized in Nyasaland by Stannus in 1910, and its presence was again reported by Milne-Tough in 1922. Observation of the pellagrins in the Central Prison Hospital, Zomba, and from cases occurring amongst the general population lead to the following conclusions: (1) That pellagra is not a disease confined solely to prisoners in Nyasaland, as was previously thought, but occurs with comparative frequency amongst the general population. (2) That pellagra is not a disease which is caused solely by diet; if it were the cases would be more numerous in the Central Prison, where all prisoners receive a similar diet both in quality and quantity. (3) That it would appear that pellagra is a disease due to toxic absorption producing certain changes in the nervous system, followed by neuritis of certain peripheral nerves. This neuritis produces trophic changes in the areas of the skin supplied by the affected nerves, with the result that the skin becomes dry and scaly from interference with its nutrition. These trophic lesions of the skin appear most marked on those parts of the body which are exposed to sunlight, but cases have been seen where the affected areas were situated on the scrotum and buttocks. The distribution of the dermatitis was absolutely symmetrical on both sides of the body. In many respects the disease resembles myxœdema. Thyroid gland, one grain daily, produced a rapid improvement in the pellagrins, even when the skin lesions were severe.

A Review of a Recent Epidemic of Bacillary Dysentery with Special Reference to a New Therapy (A. J. Boase).—The author reviews a series of 117 cases of bacillary dysentery that have been treated at the Mulago Hospital during the past six months; they represent cases that arose in the gaols of either Kampala or Luzira. The epidemic began towards the end of October and reached its height during the early part of December. The series is divided into two groups, i.e., "The Saline Group" and the "Castor Oil Group." The better results were obtained with the second method of treatment. Castor oil is not claimed to be a specific; it acts merely as a palliative. But if it is of use in reducing the death-rate and restoring the individual to his normal capacity, it is well worth a trial in the treatment of bacillary dysentery.

Note on the Trypanosomiasis Census of the Populations of the Miriu River, Central and South Kavirondo Districts, Nyanza Province (J. O. Beven).—The census was made for the purpose of ascertaining the incidence of trypanosomiasis in the most heavily infected area of the province. The Miriu forms the boundary between Central and South Kavirondo, and the population affected can be divided into three groups: two on the south bank and one on the north. On the south bank the incidence of disease is 53 per cent. in one group; the percentage of the other group is not given. On the north bank the incidence of disease was found to be 29·2 per cent. The incidence is very high among children under 16, owing to the fact that they spend the greater part of the day either actually on the river or in the adjacent bush. The number of cases admitted to hospital during the last year is over eighty. In a certain proportion trypanosomes were found in gland-smears; the formol-gel test was positive in all; the clinical evidence was quite conclusive in every case, and in no case did the result of treatment, either by "Bayer 205" or tryparsamide, fail to confirm the diagnosis. Careful inquiry has proved that trypanosomiasis never completely died out after the epidemic of 1909-1912.

The Provision of Hospital Accommodation with Particular Reference to Infectious Diseases (F. J. Carlyle Johnstone).—The author shows the necessity for increasing the expenditure on medical services, which would enable the activities of the Department throughout the Kenya Colony to be extended in many directions.

A point worthy of consideration is the desirability of providing accommodation for the treatment of infectious and communicable diseases in addition to ordinary medical and surgical cases in one general hospital. This would probably result in (*a*) considerable financial saving in the cost of hospital administration, (*b*) conservation of staff, and (*c*) more efficient treatment of the sick.

Notices.

THE WAR AGAINST MALARIA.

Sir Ronald Ross leaves for Ceylon per Bibby Line S.S. "Yorkshire."

One of the primary objects in the founding of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, S.W. 15, was to create interest throughout the Empire in waging a relentless war against malaria. There is possible to-day no disease causing more suffering and financial loss than malaria. Over twenty-five years ago Sir Ronald Ross made the discovery of the carrier of this disease, and although the successful application of his discovery has rendered certain tropical areas comparative health resorts to what they were at one time, proportionately little progress has really been made throughout tropical and semi-tropical countries.

Sir Ronald Ross in addressing recently members of the Ceylon Association, proposed a scheme calling for the co-operation of all Plantation Companies, believing it should be possible, within a short time, to drive malaria right out of Ceylon.

In certain parts of Malaya, Southern India and Assam, groups of Plantation Companies are dealing effectively with malaria, but if Sir Ronald Ross's mission succeeds it will not be a question of small areas being cleansed but the whole country. It is his intention to group Plantation Companies geographically, and each group will be dealt with by a resident malarial expert, who will carry out malaria control measures according to the conditions peculiar to his particular group, and report from time to time to a Central Committee. Every facility will be given to individuals to combat the disease effectively.

Sir Ronald Ross, K.C.B., K.C.M.G., F.R.S., is Director-in-Chief of the new Ross Institute and Hospital for Tropical Diseases, and it is hoped that his visit will create world-wide interest in the urgent necessity of dealing drastically with tropical diseases generally. This will be very beneficial to the Empire and will hasten its profitable development.

BUREAU OF HYGIENE AND TROPICAL DISEASES.

(Late Tropical Diseases Bureau).

By decision of the Honorary Managing Committee of the Tropical Diseases Bureau, and with the approval of the Secretary of State for the Colonies the Bureau's name has been changed to "Bureau of Hygiene and Tropical Diseases." The Bureau traces its history back to 1908 when as a result of the International Sleeping Sickness Conference of 1907 the Colonial Office founded the Sleeping Sickness Bureau, which for four years carried on its work of preparing and publishing the *Sleeping Sickness Bulletins* in a room put at its disposal by the Royal Society. Towards the end of this period it brought out also the *Kala Azar Bulletin* and in 1912 it outgrew its accommodation and moved to the Imperia Institute. Here its scope was widely increased an it became the Tropical Diseases Bureau, publishing i place of the journals named the *Tropical Disease Bulletin*, now in its twenty-third volume, and th *Tropical Veterinary Bulletin*, of which thirteen volume have appeared. In 1920 it again outgrew its quarter and removed to what was then the new building o the Seamen's Hospital Society at 23, Endsleig Gardens, where it occupies rooms put at its disposa by the new School of Hygiene and Tropical Medicin Last year the Managing Committee recognizing th advances made in the practice of preventive medicin and the increasing need of the tropical and othe colonies for recent information on all branches o hygiene, decided to replace the *Sanitation Supple ments* of the *Tropical Diseases Bulletin* by a monthl *Bulletin of Hygiene* planned to meet the needs of th Dominions as well as the Colonies. The new journa will make its appearance this week. Dr. J. F. G Haslam, recently Government Medical Officer Health of British Guiana, has replaced Colonel Alcock as Assistant Director, and is in editori charge of the new Bulletin. The Bureau's name now co-extensive with its activities.

January 25, 1926.

A Four-grate Front-Fed Brick Built Destruct Plant of the well-known Meldrum Simplex Standa type is ordered for the town of Woollahra, ne Sydney, and brings the number of Destructor Plan installed in Australia alone to nine—the others bei at Annandale, Marrickville, Toowoomba, Newtow Lithgow, North Sydney, Prahran, and St. Kilda.

New Preparations, Inventions, &c.

BISMUTH TREATMENT IN SYPHILIS.

During recent years the intramuscular injection of bismu salts has been widely employed in alternation with organ arsenic in the treatment of syphilis. Of the various for available it is thought that the salicylate is the mo advantageous, and Messrs. Parke, Davis and Co., now supp ampoules each containing 2 gr. of that salt suspended in pu olive oil to which is added 10 per cent. of camphor and creosote, which drugs tend to obviate pain or irritation at t site of an injection. In an average case the contents of o ampoule should be slowly injected deep into muscular tis twice a week.

Bismuth salicylate ampoules (P. D. & Co.) are supplied boxes containing 6 or 12 ampoules.

SULFOXYL SALVARSAN.

This preparation has recently been issued by Messrs. Meist Lucius and Bruning, of Hoechst, in a 5 per cent. solution rea for immediate use. Sulfoxyl Salvarsan is chiefly used in t treatment of tertiary syphilis, and is now being employed by number of hospitals and V.D. centres in this country.

"Isacen" granules brand diacetyl-dihydroxphenyl-isatin a new purgative. The salient advantages of "Isacen" a that it is non-toxic, acts in a very small dose and only in t colon, and that it is not absorbed but excreted unchanged

Original Communications.

THE SEARCH FOR A MORE EFFICIENT PROPHYLAXIS AGAINST TUBERCULOSIS.

By F. Cevey, M.D.
Privat-Docent Lausanne University.

Tuberculosis is one of the most prevalent causes of mortality amongst young people, being the cause of more than half the deaths which occur between 15 and 40 years of age [1].

I.

The formula $D = \frac{V}{R}$ (Disease = $\frac{\text{Virulence}}{\text{Resistance}}$), was used by Galli-Valerio to show the relation between the virulence of the microbe and the resistance of the infected organism. It is a prime necessity in prophylaxis to suppress, whenever possible, the numerator Virulence. On the other hand, the possibility remains of amplifying to such a degree the denominator Resistance, that the fraction ceases to have any further practical value, the arrest or failure of the disease thus manifesting itself.

In the fight against tuberculosis a series of measures has been successively proposed tending to destroy tubercular contagion, but, until now, it has given very few results. In spite of all elaborate theories, without our knowing how or why, in the majority of the cases Koch's bacillus succeeds in stealthily invading the organism and continues to defy all means of destruction.

Failing to exercise any direct efficient action against the virulence, attempts should be made to intensify the resistance to the maximum.

In view of the more or less rapid wasting in phthisical subjects it seemed indispensable, in order to preserve our population from tuberculosis, to appeal first to the general rules of hygiene and to aim at restoring in threatened individuals as great a resistance as possible. After the marked failure of drugs the vogue of bodily exercise came into use, which is quite as powerless by itself to annihilate tuberculosis.

In fact, what correlation is there between general resistance and tuberculosis? If we draw a diagram of mortality in general, at different ages, we obtain a fairly regular U curve (Diagram II) the branches of which corresponding with the extreme periods of life indicate for both periods a very high mortality. The curve falling sharply from birth to about the fifth year and maintaining from that age to about the forty-fifth year a minimum, rises abruptly afterwards and without interruption during old age.

This curve, established by the figures published by Ascher [3] for the year 1909 in Prussia, shows that the general resistance of the individual, imperfect in early childhood and in old age, attains its highest degree approximately between the fifth and forty-fifth year and suffices during this period to maintain the general mortality at a minimum.

If we establish, according to age [3], the curve of mortality from true pneumonia and that from pulmonary affections due neither to pneumonia nor tuberculosis, we obtain curves exactly parallel to that of mortality in general. Consequently, it is most surprising that for tuberculosis and for pulmonary tuberculosis we get an absolutely different curve, presenting from birth a decrease until about the fifth year, rising slowly at first and from the eighteenth year more and more rapidly, attaining the highest maximum shortly after the twenty-fifth year and remaining at that level until the forty-fifth year with very little variation. After a further rise the curve then falls considerably in extreme old age; this last decrease and the stagnation of the curve between 25 and 45 are most probably due to the treatment on a large scale of tuberculosis amongst the working class by the German National Health Insurance. For the years preceding its activity, the rise in the curve of mortality from tuberculosis, on the contrary, in adults continues at the former rate from the twenty-fifth year to extreme old age.

A first fundamental conclusion is evolved from this study of mortality: *A good general resistance of the individual does not by any means imply a good resistance against tuberculosis.* It is precisely in the years when the general resistance is best that we find the highest mortality from tuberculosis. It is towards correcting this lack of parallelism that the fight against tuberculosis must tend; one sees from the mean part of the curve at least, that before 1914 the Germans had partly succeeded in this task. The disparity which still exists between the two curves (from mortality in general and from tuberculosis) allows us to measure the social effort still to be effected.

When we shall have brought the curve of mortality from tuberculosis between the fifth and forty-fifth year parallel to the curve of mortality in general we shall have socially accomplished all the progress which may be reasonably expected in this sphere. Another consequence is that from the disparity of these curves we can estimate, according to age, how many individuals die each year from tuberculosis whom we could save if there was a better understood form of prophylaxis.

Not only the study of the table of mortality, but direct observation on the living confirms that the resistance to tuberculosis is not identical with the general resistance of the subject. That those races who exist in the Fuegia Islands [4] and in Southern Arabia [5] have remained free from tuberculosis proves this clearly. In these tribes of an astonishingly vigorous physique and among those leading a nomad life, who can stand any rough weather, the least tubercular contamination is inevitably and rapidly fatal.

It is the same with animals: the Hungarian oxen living in a savage state, and captured by the lasso never show symptoms of tuberculosis, which has been abundantly verified post mortem; but six months of stabling in company with domestic oxen,

not specially chosen, suffice, however, according to Ostertag [6], to make them all tuberculous. Thus life in the open air and absolute endurance to atmospheric conditions have not contributed in developing in these animals any trace whatever of resistance against tuberculosis.

An analogical instance, particularly conclusive, is given by the Swiss Army, which undergoes intense sportive training during the mobilization. One would expect to find a decrease in the number of manifest tuberculous cases during the ensuing years, but precisely the contrary is shown. In 1914 there were 107 soldiers incapacitated by tuberculosis in the Swiss Army, 688 in 1915, 790 in 1916, 1,244 in 1917 [7], and 2,168 in 1918!

If in European countries numbers of weak and poorly developed citizens are capable of astonishing resistance to the tubercular infection, which is certain to prove rapidly fatal to an Indian Onas, physically well trained, it points directly to the fact that in the former the increased resistance is already a specific phenomenon of immunity, showing a sort of previously weakened vaccination of the race which enjoys consequently a resistance which, with a very superior training in the open air and a life of exposure to the elements, it has been powerless to endow upon the aborigines of the Fuegia Islands.

Hence, *the resistance to tubercular infection is of a specific nature*, depending, like all biological phenomena, in a certain measure, on the general condition of the subject, but not identifying itself with it. On the contrary, an excellent general condition can exist without any resistance against tuberculosis.

It is incomprehensible that whilst nature itself shows us in immunization the sure way to preservation and cure, we still persist in trying to increase the resistance against tuberculosis in children and adolescents only by non-specific means, which alone cannot secure complete success.

"Prevention is better than cure" has been echoed and re-echoed, and the so-called prevention of tuberculosis was decreed. This is a very praiseworthy aim, but it must be clearly defined.

It is important to aim at preventing the infection in infancy by seeking to diminish all exposure to contagion, and to try by direct measures against the bacillus to check the actual general contamination, though there is considerable difficulty in such a task.

On the contrary, and here lies the error, if to secure prevention of tuberculosis in children one pretends to make them escape contamination from Koch's bacilli in recommending life in the open air, sun and air baths, open air schools, sports, &c., we formally contest that such a result can be realized.

Until recently physicians still recognized in children a certain number of signs and stigmata which were characteristic of a predisposition to tuberculosis.

However, and here is a new point, actual biological methods allow us to assert that in reality such a predisposition does not exist. By a more rigorous examination, one after the other the signs which were described can be proved either to be without any causal relation to tuberculosis and due, for example, to rickets, syphilis, &c., or are symptomatic of tubercular infection of which they indicate a rather slow and torpid evolution.

Thus the loss of appetite and strength, certain digestive troubles, anæmia, the stooping attitude, the loss of weight, flattening of the thoracic wall, premature ossification of the costal cartilages, prominence of the scapula, atrophy of certain groups of muscles, the fleeting or persistent flush of the cheeks, the acceleration of the pulse, the instability of the temperature are, considered in groups or altogether, not signs of a predisposition, but already symptoms of tubercular infection itself.

It is in the same way that certain characteristics of physiognomy should be interpreted, easier to recognize than to define, and the significance of which did not escape the sagacity of ancient authors; thus a particular brightness of the eye and of the hair, a certain fulness of the figure, complexion fresh and rosy, to cite only a few of these traits, completed the picture of the "tuberculous beauty."

On the contrary, having duly ascertained the absence of infection, nothing authorizes us to diagnose in the person considered a particular predisposition to tuberculosis. Numerous authors are even of opinion, and the statistics of orphanages sanction their saying, that children of tubercular parents, separated from them as a preventive measure and not yet infected by them, do not show later any particular predisposition toward tuberculous disease, and indeed contract it more rarely than their comrades with an unburdened heredity [8].

In consequence, when philanthropy exerts itself "to prevent" tuberculosis in its "protégés" it is dealing with two distinct groups: On the one hand those not yet infected by Koch's bacilli, but merely underfed or suffering from various affections need appropriate treatment. Since these children have remained unaffected by tuberculosis in such conditions, it is an error to describe as "preventive" the mode of life to which they will be subjected by their protectors. On the other hand, in the ever-increasing number of children infected by tuberculosis, with its stealthy evolution and tendency to generalization, it is not a question of preventing, but of curing it.

We are little advanced in the prevention of tuberculosis, and the reasons are evident. Aiming at prevention, philanthropists, when they temporarily assist children infected by tuberculosis, are already in reality unconsciously *treating* them. *At the moment when an energetic intervention would easily and definitely in most cases arrest the infection, the child, by regrettable error, benefits only by an absolutely insufficient and merely preliminary treatment, from which any definite result cannot be expected.*

Thus, as we remarked in a recent work [9], "the predisposed" is in reality already a patient

hom it is necessary to help without delay, and
t when, after months and years of useless fight-
g against the invading infection, the appearance
indubitable clinical signs of the disease portends
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To preserve children infected by tuberculosis
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certain cure and lead them to normal working
e, a change of air, some weeks of rest and abun-
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rect in their young organism the still waver-
g functions of defence, it is necessary to have
course to a *treatment* capable of intensifying these
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ch a manner as not only to hold the tubercular
fection in check, but definitely to arrest its course.
r *better prevention let us learn to cure.*

* * * *

To the habitual notion of prevention of the
bercular infection in children, too often impos-
ble to realize in a given time, we have to sub-
itute that of an energetic treatment, as early
possible. Let us briefly examine the programme
d its possibilities.

The increased resistance to tuberculosis appears
the race as in the individual, as a specific
henomenon of immunity. The treatment must
im at entirely constituting or more frequently
restoring this resistance, the denominator of the
fraction showing the declared conflict between the
thogenic agent and the organism. The equili-
rium which manifests itself by the arrest of the
fection having at last been obtained, it will be
cessary to ensure, if possible, its consolidation
d by intensifying the resistance still more con-
derably, to render it definite.

What better method in experimental pathology
an immunization in its diverse forms allows us
develop the defence so as not only to increase
tenfold, but even to make the organism sustain,
thout injury, doses of bacterial poisons a thousand
mes the fatal dose?

If by immunization medicine has been able to
lebrate such triumphs in other spheres, why
hould we persist in ignoring its advantages in the
ght against tubercular infection? Doubtless we
ve not yet at command an approved vaccination
y attenuated bacilli against it (reserve being made
ntil further time-control for Calmette's new
ethod of vaccination). Does it then follow that
here is at the moment, in this respect, no other
ay leading to success?

An experience of more than twenty years allows
s to certify that, by using derived products such
diverse tuberculines, bacillary emulsion, &c., it
possible, if all the proper precautions are taken,
nd if sufficiently large doses are given, to obtain
uch an increase of the resistance in more than
0 per cent. of the cases, and one can only explain
hese results as being due to active immunization.

Our affirmation does not concern only the so-called "pretubercular cases" in which the result is still more striking, but also the cases of tuberculosis still curable. In these latter we can observe, parallel with the progress of the treatment, the cessation of toxic phenomena, with improvement in the weight, temperature, pulse and blood-pressure, diminution and then disappearance of the cough, expectoration and bacilli, healing of tubercular lesions and wounds, return of strength, and of a state of health which allows the complete resumption of work. At the same time we find in the person who has been treated a series of modifications of the blood and of the serum reactions (precipitation, deviation of the complement, opsonic index, Arneth table, &c.), evidence of the real transformation of the organic defence, but of which on many points the definite significance still remains to be established.

In cases of advanced decay and destruction (except, if the possibility of preliminary local intervention such as artificial pneumothorax, thoracoplasty, &c., transforming the situation, can be considered) the immunisatory training would, of course, be out of the question.

That training aims at stimulating the production of antibodies, rendering the subject, little by little, immune to the toxic products of the bacilli more rapidly than the progress of the infection.

The result of treatment will clearly manifest itself only when the organism, in response to the immunizing stimulation exercised in healthy tissue, will produce antibodies in sufficient abundance, to neutralize, proportionately to their diffusion, the toxic products elaborated by the tubercular foci. The subject, until then, in a more or less chronic state of toxæmia, will find himself, after treatment, in a condition analogous to that of a pneumonic patient after the crisis. It is this equilibrium of the resistance still unstable in the beginning, which the ulterior treatment must consolidate and render definite.

The production of antibodies being proportionate to the quantity of antigen administered, one realizes the impossibility of obtaining sufficient antibodies by the administration of minute doses of antigen. It is consequently useless to linger, in the course of the treatment, over too small doses of tuberculin, which cannot lead to anything.

We always advise beginners, after a complete and serious study of the question, to start by treating slight cases of the disease. Having seen the results, little by little, the physician will have more and more confidence in the method, and gain further experience, which will allow him to undertake with success the more serious cases. He will also have acquired the necessary authority for the psychotherapeutic part of the treatment, always so important with the tubercular patients, too often capricious and easily discouraged.

II.

In the foregoing, we have shown the necessity of developing, as far as possible, in all the infected

subjects, by means of a sufficient immunisatory training, as strong a specific resistance as possible against tuberculosis, since a good general condition does not *ipso facto* indicate a resistance against the infection as sufficient as might have been expected.

From the fact that many individuals with an ailing appearance have for years shown a marked resistance to tuberculosis it would, nevertheless, be absurd to conclude, conversely, that resistance is without any correlation to the general condition. It is well known that after a certain degree of organic wasting no further particular resistance is manifested with regard to the infection, and then its more and more accelerated course henceforth advances irremediably.

In these circumstances, if it is legitimate to connect the simultaneous lowering of the general condition with the progress of the infection, it is natural to infer, during improvement in the course of treatment, a temporary abatement or even a real remission of the infection. It is thus very important to record the variation of the patient's condition of nutrition along with the direct clinical manifestations.

As regards this, we must proclaim as an important improvement the introduction by Pirquet [10] of a formula of general value, which characterizes rapidly, and with sufficient exactness the state of nutrition. The usual simple record of the weight is, indeed, only of value so long as the age, height and sex of the subject are considered. If we are dealing with a child, as a result of the increase in size that may have occurred, an increase in weight, in a given time, does not necessarily signify a corresponding amelioration in the state of nutrition.

If one wishes to compare the state of nutrition in different subjects, the unequal individual development of the legs also conduces to falsify the results, based merely upon measuring the height. One sees from this, considering the various elements in question, how complicated, in reality, such comparisons are and how easily they are rendered erroneous.

Relying on the former works of Henning, which establish that in man the length of the intestine is equal to about ten times the height (H) of the subject seated (measuring from the seat to the vertex) Pirquet shows that the intestinal surface itself corresponds to the square of this length (H^2). Extending his research, Pirquet also verifies that the cube of (H) is equal to ten times the weight of the body in grammes (P). Thus, the state of nutrition $N = \frac{\sqrt[3]{P}}{H}$; a formula to which, by the contraction of a Latin phrase defining it, the inventor has given the name of *pelidisi*.

According to Pirquet, the normal pelidisi of an adult is equal to 100, and in physiological limits may be raised to 105 in fat individuals, and fall to 95 in thin individuals. In the growing child, the pelidisi is a little lower. One may admit, in general, however, that a fall below 94·5 indicates a condition of under-nutrition ; when it reaches 92 and under, the American Mission d Help, which has applied this formula on a larg scale, considers that the under-nutrition thus re vealed is an indication that a supplementary gran for nourishment should be made.

The value limit of 94·5 having been definitel confirmed by the repeated examination of mor than 150,000 children, it is not necessary to insis on the considerable practical importance of th pelidisi for the rapid and sufficient determinatio of the state of nutrition.

Citing a personal instance, I will indicate th comparison of the state of nutrition in two youn girls, aged 8 and 9 years respectively, and of th same height, measuring 133 cm., the first weighin 30·3 kg., the second 28·6 kg. Do they both show good state of nutrition, and in which is it mor accentuated? The calculation of the pelidi allows us to determine these questions easily an without ambiguity.

The first little girl measuring, when seate 72 cm., the second only 68 cm. (H value), th result is that the latter has a pelidisi = 96· absolutely satisfactory for a child, whilst her litt companion, who has a more favourable appearanc if one judges in the usual way, having the sam height, but being heavier by 1·7 kg. presents reality a pelidisi of only 93·3, which shows u deniable under-nutrition, unsuspected till then.

Pirquet cites, on the other hand, the followi instance: the weight of a nursling has passed f tween the third and sixteenth week from 3·7 k to 5·25 kg., increasing thus by 42 per cent. Durin this time the pelidisi has, nevertheless, remaine unchanged — 94, the value of H having passe from 35 to 40 cm.

Inversely, the investigation of the pelidisi allow one to calculate the optimum weight for eac child. One thus sees the usefulness of the i vestigation of the pelidisi chiefly for the children specialist, and the resulting advantage for the ear diagnosis of under-nutrition.

* * * *

Asked by the committee of the Society "Sa feu ni lieu" to treat in the "Pavillon Bourget at Croisettes s/Lausanne, fifty little French ch dren from the devastated areas, all infected tuberculosis, and of whom about twenty show the usual local glands, as well as light pleural pulmonary symptoms, it seemed interesting to stu the variations of the pelidisi in the course of thr and a half months of immunisatory training which we subjected them. Without exception, t children have all increased in weight in the cou of the treatment, from 0·8 to 8·1 kg., the increa on an average being more than 3·3 kg.

Diagram I indicates the variations of the pelid in these children. It shows that on their arri only 6 per cent. of the children were in a w nourished condition, 34 per cent. were und nourished, and in 60 per cent. the under-nutrit was still more marked. After three and a h months' treatment, one could record that for 6

cent. of the children the respective gain in weight had been 2·200 to 2·900 kg., but, nevertheless, not sufficient to compensate their marked under-nutrition. In 18 per cent. of them who had gained from 1·900 to 5 kg., simple under-nutrition was still present, and in 76 per cent. an absolutely normal state of nutrition was found.

These results may be considered, without exaggeration, as entirely satisfactory; it is interesting to compare them, *si parva licet* . . . . with those obtained in Austria in 1920, by the American Mission of Help.

A first study of the pelidisi in the Austrian children showed that nutrition was more defective in Vienna [11-12] (average pelidisi = 91·6) than in certain towns of lower Austria, where it was found necessary to distribute food (average pelidisi = 89·04), and slightly better in the remaining towns where this distribution was withheld (average pelidisi = 93·68).

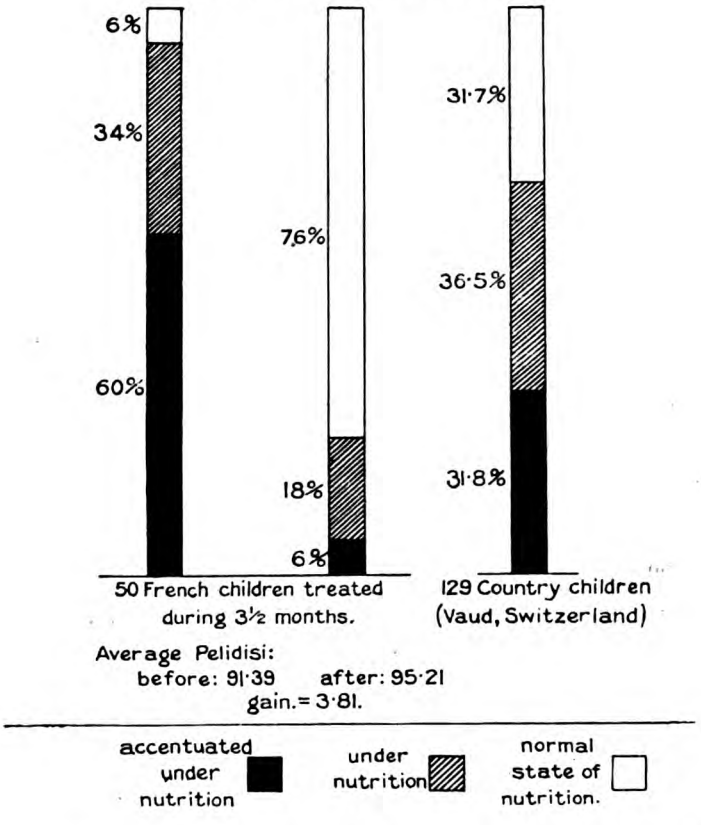
After six to nine months' assistance, including up to 400,000 meals per day, on a fresh examination of the children it was found that in Vienna the average amelioration of the pelidisi was 0·90, and in the assisted children in the towns of lower Austria 0·35, whilst in the unassisted children of the other towns the average pelidisi had, on the contrary, fallen during the period considered by the same amount of 0·35.

In the French children infected by tuberculosis the state of nutrition on their arrival was worse than in the children of Vienna, the average pelidisi not being more than 91·39. Considering the limited resources, they were given very simple but sufficient food, and treatment by tuberculin was carefully individualized, enabling them to support without reaction and in perfect condition varying doses reaching, after three and a half months, in a number of them, a final dose exceeding half a gramme of Koch's old tuberculin.

Under these conditions, *the average pelidisi of the children treated had risen* 3·81 (*i.e. to* 95·21), thus *showing, in a period of two or three times shorter, an increase fourfold that obtained by the American Society of Help* in Vienna by the sole use of supplementary food. It seems difficult to illustrate better the advantages of this specific training of the resistance the importance of which, for getting rid of tuberculosis, we have shown previously.

DIAGRAM I.

CHANGES IN THE STATE OF NUTRITION.



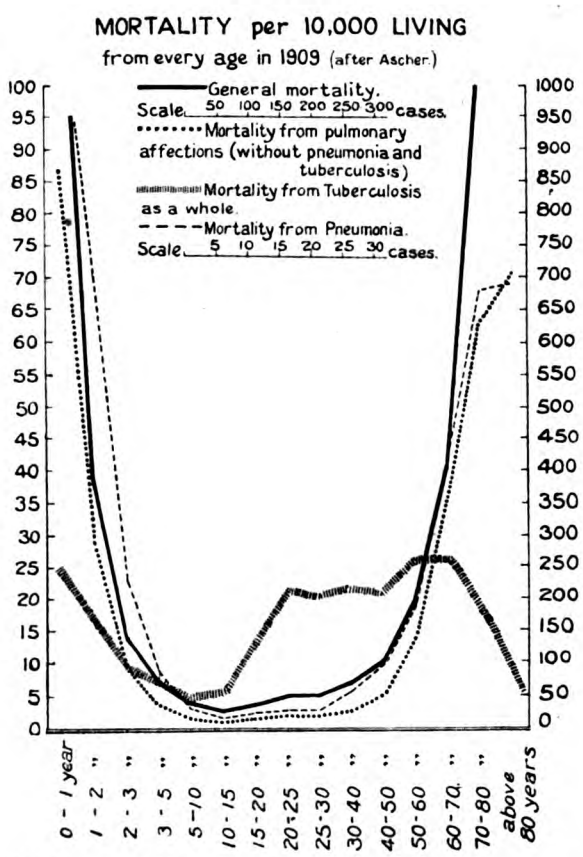
* * * *

To appreciate the entire value of the above result, with the fifty protégés of " Sans feu ni lieu," it was still necessary to compare their state of

nutrition at the end of the treatment with that of Swiss children, living in the country, with regard to whom no statistics had been previously established.

For that purpose we have examined six classes of children (129), representing almost the entire infant population of two prosperous villages taken at random, in no way different from the neighbouring villages, not having any factory and being entirely devoted to farming. The results of our investigation have proved most disappointing. (See Diagram I.) We found a good state of nutrition only in 31·7 per cent. of the children, under-nutri-

DIAGRAM II.



The scale figures on the left of the chart represent the mortality from specific complaints; the figures on the right represent the general mortality scale (the heavy line).

tion in 36·5 per cent. and accentuated under-nutrition in 31·8 per cent.

A definite conclusion may be drawn from these facts: On their arrival in Switzerland, the fifty French children were suffering from under-nutrition and tubercular infection: considered only as "predisposed" they would simply have been lodged in the country like their companions of the holiday-camps. Under these conditions, even in prolonging their stay indefinitely, one could not reasonably hope to see them surpass, as regards their state of nutrition, the country children with whom they would have been kept. In other words, instead of finding, as on their arrival, a good state of nutrition in only 6 per cent. of the children, one could have found it on their departure at the most in 31·7 per cent. of them as among the peasant children of the country.

In reality, in addition to simple but sufficient nourishment, the children were given an accelerated treatment for their tuberculous infection; after three and a half months, 76 per cent. of them showed a good state of nutrition. It is, therefore, no exaggeration to attribute this considerable increase in the percentage of the children, with normal pelidisi, to the special treatment that was granted them.

In short, in not only correcting the under-nourishment, but, *by treating at the same time the accompanying tubercular infection, the gain realized as to nutrition has been more than doubled.* (76 per cent. compared with 31·7 per cent.)

* * * *

Why do we encounter such defective nutrition in our country children? Must we blame a defective diet badly adapted to the child, although sufficiently abundant? Since by actively treating the children infected by tuberculosis, one finally arrives at the result that a normal state of nutrition is found among them, about two and a half times more frequently than amongst the peasant children of the district. Does this mean that in the infant population of our country districts, reputed as healthy, the tuberculous infection is much more widely spread than is generally thought, and is responsible for the existing state of malnutrition?

We may be well enough informed regarding the frequency of the tuberculous infection in children living in towns, and particularly in large towns, but we still lack positive information as to its prevalence in the country districts. It is indeed far from easy to obtain information regarding it. The peasants are apt to look with distrust on the intervention of the physician, and the simple reaction of Pirquet, however, inoffensive, cannot be practised without difficulty in series, except in hospitals.

Consequently we acknowledge the good sense and intelligent goodwill of our peasants. When advised of what we were asking, they immediately placed their children at our disposal, thus ensuring the prompt success of our inquiry. The results unfortunately, more than confirmed our apprehensions. In the youngest children (from 7 to 10 years) a positive Pirquet was present in 29·4 per cent. and in the older children (from 10 to 15 years) we found it in 61·1 per cent., i.e. twice more frequently.

As it is hardly possible that contamination in the family be greater after ten years of age than earlier, it is probably to the schools, until further information, that we must attribute this formidable increase of the infection between 10 and 15 years.

The objection may be made that our research refers to a limited number of children; we regret this very much. However, having examined, with

few exceptions, all the children attending the village school, in a district in no way conspicuous by its tubercular mortality, we doubt whether the result, if recorded elsewhere, would be essentially different.

Undoubtedly there is an important and extensive inquiry to be made, which only the Government can achieve satisfactorily. The elementary school being obligatory in our country, we have the right to exact that full guarantee be given that children cannot contract tuberculosis there.

We can now elucidate a last point of our study, namely, whether the established bad state of nutrition of our country children is due to an unsuitable diet, or, is not, as we presumed, the direct consequence of tubercular infection, hindering the child from thriving.

If the latter hypothesis be correct, we must find the average pelidisi in the uninfected children normal and the contrary in the others. In fact, we observed in the children from 10 to 15 years with a negative Pirquet an average pelidisi of 94·56, indicating a good state of nutrition, while the mean pelidisi in the group with a positive Pirquet had not exceeded 93·47, indicating a characterized state of under-nutrition. Since we have no reason to think that the food was different for these two groups of children, or that one of them had received unsuitable food, it follows *that the under-nutrition observed is in direct correlation with the extent of the tubercular infection.*

* * * *

Thus we find in the country, as well as in the cities, a considerable tubercular infection in children, undermining their vitality. Later they become patients, but before joining the ranks of those who die as a rule between 15 and 40, they will not fail to infect new generations of children, thus ensuring the perennity of the vicious circle. What remedy is there?

First, we must not wait to fight the infection until it has become a disease, difficult to cure and dangerous to others. We must, on the contrary, look for it in its earliest stages, by the systematic examination of the children at school (clinical symptoms, pelidisi, X-rays and Pirquet's reaction). At the first sign of under-nutrition and diminished resistance, we must immediately intervene with an energetic treatment, in which immunisatory training must *precede* physical training. Later on it will be necessary to examine periodically the cases dealt with, in order to treat them again in good time, if necessary. Simultaneously, one must prevent, as far as possible, the spread of infection (education and instruction of the people, especially of the patients, obligatory disinfection of each apartment on every change of tenants), &c.

Such a programme can succeed only with the help and active participation of the Government and that of physicians who must be carefully trained for this special task and, to be fair, receive a satisfactory remuneration for it.

Whatever diverging opinions there may now be, regarding both the respective value of the proposed treatment and that of the physical training to which philanthropists endeavour to subject the children, it is quite evident that all physical training would be considerably facilitated if, by a previous immunisatory training, three-quarters, instead of one-third, of those subjected to it, presented, from the beginning, a satisfactory state of nutrition. At any rate, it will be agreed that a method which is capable in three or four months of providing for tubercle-infected children a satisfactory state of nutrition in a percentage two and a half times greater than that encountered among children enjoying country life all the year round, deserves the attention of hygienists and physicians.

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A CONTRIBUTION TO THE STUDY OF THE PATHOGENESIS AND TREATMENT OF SEA-SICKNESS.

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SEA-SICKNESS owes its origin historically to the same epoch as navigation itself. It is only seldom that among those who take a sea voyage for the first time there are not some who pay tribute to the disturbance of sea-sickness; but in general only until habit has accustomed them to the ill-effects of the sea. There exist, however, special conditions of the movements of ships which produce this malady even in the oldest and most experienced navigators, whilst there are some who, in spite of habituation, never succeed in conquering their special predisposition, and amongst such are not to be missed as examples the names of great admirals, such as Nelson, Tegethoff and others, who continued to suffer from sea-sickness on the slightest movement of the ship. Towards the middle of the modern epoch, when navigation commenced to assume vast proportions, authors began to concern themselves with this disease, and to-day there exist no less than 300 synthetic reviews on sea-sickness, but of all the theories which have been evolved to explain its pathogenesis none have with-

stood the rigours of criticism, so that therapy still remains inefficient.

I.—Ætiology.

The principal cause of the manifestations and the disturbances in sea-sickness is given as the movements of the ship, movements that aggravate the syndrome in proportion to their variety and violence.

It is well known that the principal movements which the waves impress on a ship are two: (1) Rolling (movements in the longitudinal axis); (2) pitching (movements in the transverse axis). Pitching causes greater suffering than rolling. There exist also disordered movements which impose the most varied oscillations on the ship on which I have laid some little stress, and which do not permit of complete well-being even in those who have long been habituated to navigation, except those who are endowed with absolute refractoriness.

More than a malady, sea-sickness is a functional disorder which sometimes presents characters of real gravity, from simple oppression or slight nausea to persistent and intractable vomiting accompanied by phenomena of suffering generally irrepressible and producing a really painful symptomatic picture. Women are generally more susceptible to sea-sickness than men, and this is easily explained when account is taken of their sensibility, excitability, and gracile constitution, which account for their greater predisposition.

Regarding age, it is ascertained that children and old people are more rarely subject to it, from which observation has sprung perhaps the most ancient opinion thereon, first expressed and upheld by Plutarch, and then in times not remote by Guepratte, that sea-sickness was for the most part due to impressions and to fear; Guepratte also supported this hypothesis, averring that he had observed that children, like animals, became similarly immune to it. However, I can affirm that he had not made a very precise observation, since what had in effect been seen by many others had escaped him, and that is that children, even more rarely than adults, for a reason which I shall more closely deal with, are similarly affected by sea-sickness, and that not even dogs, monkeys and horses are exempt from all the very grave disturbances which the movements of the ship cause.

II.—Predisposing Causes.

Poor digestion and overfilling of the stomach, as well as absolute fasting, are causes predisposing to sea-sickness. Other predisposing causes are disgusting sensations such as a penetrating stench, vitiated air, the smell of the kitchen, the sight of persons vomiting, &c.

III.—Symptomatology.

Sea-sickness begins with a sense of general malaise and heaviness of the head, a state of abulia and vertigo. On this first disturbance there follows often with great precipitancy severe nausea, accompanied by salient vasomotor phenomena; the face becomes very pallid, the extremities cold and cyanotic, and the respiration embarrassed. All these phenomena reach a culminating point when vomiting ensues, aft which a slight but false relief of suffering follow with another brusque movement of the ship, howev all the symptoms return in aggravated form and t patient then presents a syndrome of real gravi Sea-sickness subsides at once on the cessation of t cause and it rarely leaves any sequelæ. No fa cases can be attributed to it.

IV.—Pathogenesis.

Much—indeed too much—has been written on t pathogenesis of sea-sickness and many and varic are the theories which have been enunciated a upheld. Without detailing the history and criticis of these hypotheses, I limit myself to a sim enumeration:—

(1) Theory based on the influence of fear on t psyche. This theory was held by Plutarch, and m recently by Guepratte, but has no serious foundati

(2) Theory of the miasmatic or microbic ca (Semanas), not now held by anyone.

(3) Theory of diminished force of the blood in t arteries (Pellerin and Fischer)—opposed to the the of Wollastone—has not withstood the simpl criticism.

(4) Theory of the congestion of a special segment the nerve centres and of the spinal medulla; not ev the author justified this hypothesis experimentally.

(5) Theory of repeated cerebral commotion; fi held by Fopsagewiss and later by Lusey and Janowl a theory also easily destroyed.

(6) Theory of the ennervation of the cephalo-rac dian fluid, held by Antric in his "Theorie phisiologiq du mal de mer." This one-sided theory was also eas destroyed by valid arguments.

(7) Theory of otic vertigo, enunciated by Erasm Darwin and developed by Arronsohne, Orsian, Bonn Hewitt and Wilson Fox; a theory which at first h a certain amount of support, but has lately be abandoned.

(8) Theory of muscular effort necessary for t maintenance of equilibrum (de Rochas); easily co bated by the fact that complete relaxation of all t muscles by assuming the horizontal posture do not abolish the symptoms.

(9) Theory of the perturbation of the static cent (semicircular canals, cerebellum). In recent tim much attention has been paid to the condition of t circulation in general, and that of the organs particular. Bedart was the first to connect sea-sic ness with a variation in the direction of gravit According to the author visual vertigo does not appe capable of producing those variations to which mari vertigo is due. This hypothesis, recognized as being some importance, did not explain how the variatio in the direction of gravity could act on the ampul and the semicircular canals, which, according Reynold, Darnall, Massini, Barnett, &c. should pl the salient part in the pathogenesis of this malad especially as Bedart affirmed that deaf-mutes we immune from sea-sickness.

(10) Psycho-somatic theory of Rosenbach. He he that the pathological state in sea-sickness consists

local anomaly of the functions of those organs which are most susceptible to tossing movements without the intervention of the nervous system, the action of which would be secondary.

(11) Theory of the repeated difference of pressure between the liquids and solids of the organism (Letlener and Fischl).

(12) Theory of diminished respiratory exchange (Dubois).

(13) Theory of nervous and muscular exhaustion and hyperexcitability of the centre of equilibrium (Schwerdt).

(14) Theory of the circulatory modification of the brain (Bing).

(15) Reflex theory (Haegen-Torn).

(16) Theory of the agitation of the abdominal viscera and splenic hyperæmia (Dutremblay, Kerandsen, Calliano, Rotondi).

Amid so many discordant opinions it is difficult to obtain a definite concept on the genesis of sea-sickness, many having accepted an eclecticism which somewhat cloaks our ignorance of the phenomenon.

Doubtless other things than movements of the ship which constitute the prime cause of sea-sickness, are capable of favouring and augmenting it, such as the atmospheric conditions, direction of the wind, the temperature of the surroundings, the smell of tar, of cooking and of smoke, dietetic errors, the intestinal functions, mental sufferings, abnormal nervous excitability, &c. Eliminating, however, the concomitant and predisposing causes, we come to consider the pathogenesis of the disorder, endeavouring among so many theories to arrive at that which is in harmony with experimental data, and with symptoms presented by every sufferer, and with criteria *ex juvantibus*, and which can be accepted as the most logical and most responsive to the control of research.

The theories which most fulfil these conditions appear to be:—

(1) The theory of Darnall, Massini, and Barnett, that of perturbation of the static centre.

(2) The theory of Dutremblay, Calliano, Rotondi, that of agitation of the abdominal viscera.

(3) The theory of Nolf (upheld also by others), that of vertigo from excitation of the vestibular nerve by hyperæmia of the semicircular canals producing irritation of the vagus.

The first is undoubtedly the most important, as in sea-sickness circulatory disturbances are well-marked. All explanations, however, fail to determine the nature and grade of the modifications of the encephalic circulation in its relation as cause and effect of the altered functions of the other organs.

The second, that is, concussion of the abdominal organs and consecutive irritation of the ganglia and flexures corresponding to them (Kerandsen, Dutremblay, Calliano), was held in great consideration, so much the more that the critera *ex juvantibus* when tested mechanically and therapeutically appeared to give positive results.

I consider that the results obtained were due to an action which combated some of the symptoms but not the cause, against which we ought to concentrate our forces, and not merely against phenomena which are the consequences of it. Again, therapeutic criteria demonstrate that vasodilators (amyl nitrite) and mechanical means (compression of the cœliac plexus) give results of little or no account. The slight relief from bromides has slightly diminished the suffering from sea-sickness, acting as they do in all cases of suffering and pain by their calming action on the whole organism.

Recently a gastro-suprarenal theory has been enunciated, but I attach little importance to it. It is also necessary to study diligently the mechanism of action of the symptomatological movement *ab origine*, and then to ascertain the precise therapeutic measures to counteract it. Nolf's theory is undoubtedly the most acceptable, being the most logical and complete.

V.—Personal Researches.

These were made during voyages from Genoa to Rio de Janeiro and to New York and in the Mediterranean, under the guidance of Professor E. Bertarelli. I experimented with a complex remedy, named "zoe," which produces ischæmia of the ear with an elective calming action on the pneumogastric. It comprises two liquids, one of which is applied as a tampon soaked with it to the external auditory meatus, and the other is taken as drops, and its effect is immediate and lasts for seven hours.

Rather than enumerate the successes of these experiences I prefer to describe proved and interesting cases. Above all, I can with confidence affirm that in all those cases in which instead of sea-sickness disturbances from slight movements occur, tampons on the ear alone have caused disappearance of the premonitory state of malaise and nausea which preludes sea-sickness proper. In most other cases the drops of the preparation have excited an almost immediate sedative action. Here are two cases which appear to be of special interest:—

(1) On the steamer "Tocra" between Civitavecchia and Terranova, the traveller R., before embarking took fifty drops of the preparation. The sea was high and the departure of the vessel was delayed by the difficulty in leaving port. The patient had affirmed explicitly that he was extremely sensitive to sea-sickness, which in him was comparatively violent from the slightest movement. On leaving port the patient was able to walk about, to smoke, and to eat, retiring to his cabin at eleven o'clock to sleep. Next morning he awoke in good condition and commenced to rise to perform the usual toilet, but had scarcely assumed the erect posture when he was suddenly seized with vertigo and vomiting. He then lay down and took another twenty-five drops of the medicament; in eight minutes he was able to return to the deck, where he remained walking and talking to the end of the voyage.

(2) Signora M. C., a very sensitive subject to sea-sickness, had wished to take a voyage to Capri, relying on the calmness of the Parthenopian Gulf, but was about to disembark at Sorrento, a prey to the gravest disturbances. The husband, somewhat more

resistant, had also suffered severely. Supplied with the medicament they were persuaded to continue the voyage, which they then completed without any further disturbance. It is unnecessary to relate further cases, all equally successful. In all I encountered a toxic excitation of the vagus during the sea-sickness.

The Theory of Nolf.—Dr. P. Nolf, Professor in the University of Liege, published an original memoir on sea-sickness in 1921. He confirmed the already ancient opinion of the vertiginous origin of sea-sickness, adding newly-acquired information on labyrinthine vertigo. The essential organ of equilibrium is situated in the internal ear and consists of the three semicircular canals arranged in three planes and containing lymph affected by movements of the head. These movements of the head affect the extremities of the vestibular nerves, so that normally the vestibular apparatus constitutes the principal organ of the sense of equilibrium.

Excitation of the vestibular nerve in man provokes oscillatory movements of the ocular globe known as nystagmus, with a sense of loss of equilibrium and vertigo. According to Nolf, this vertiginous expression exists in sea-sickness, but does not constitute its essential character. The vertigo, if sufficiently intense, is accompanied by a sensation of malaise, cold sweats, salivation, cardiac palpitation, facial pallor, sense of prostration, nausea, vomiting and diarrhœa. This is precisely the syndrome observed in sensitive subjects after excitation of the vestibular nerves, either by a simple injection of cold or warm water into the external auditory meatus by the voltaic current, after simply turning in a revolving chair or in a game of carousel or see-saw.

These reactions are readily explained if one recalls that the vestibular nerves are in the immediate neighbourhood of the nerve roots and nuclei of origin of the salivary nerves and the nerves of vegetative life, the tenth pair (pneumogastric or vagus).

Equally by the laws of nervous irradiation, every irritation of the vestibular nerve should diffuse towards these nuclei and create a state of hyperexcitability of the nervous elements of which they are composed.

Excessive salivation results from excitation of the salivary nerves, and from excitation of the pneumogastric a complex of symptoms on the part of the heart and the digestive tube. This nerve furnishes moderating fibres to the cardiac muscle the excitation of which provokes, at its greatest, arrest of the heart, slighter diminution in the frequency and intensity of its contractions. Hyperexcitation of the vagus nerve, termed also vagotonia, tends to diminish the work of the heart, and consequently the velocity of circulating blood. It also explains the state of malaise and of more or less profound depression of strength, with a tendency to syncope.

In comparison with the cardiac fibres of the pneumogastric the filaments of this nerve, which supply the digestive tube, are excited by the mobility of this organ, so that the hypertonia of the vagus creates a condition of generalized spasm or of contraction of the digestive apparatus. This retards the passage of stomach contents towards the intestine, establishing a spasm of the pylorus. This results sooner or later in drainage to this organ, as shown by vomiting, the inevitable consequence of spasm of the pylorus.

Sea-sickness, even in the most sensitive persons, is not produced instantaneously; it is due to abnormal excitation of the vestibular apparatus by incessant changes, and rarely to the position of the body on the ship in movement; it is augmented by the view of the movement of the ship or its contents, of the waves, and probably also by the disharmony between the motor reaction which results from vestibular excitation, and the forces, more or less deranged, of equilibrium.

To sum up, in its essential elements, sea-sickness, according to Nolf, is a reflex, and, like all reflexes, comprises an afferent or centripetal path towards the central nervous system, a centre, and an efferent or centrifugal path. The centripetal path is the vestibular nerve, the centre is constituted by the fibres of origin of the cranial nerves, which preside over the functions of the heart and digestive tube and its annexes. The centrifugal paths are distributed in the cranial nerves, and particularly in the pneumogastric. Hence the final result of the reflex is an exaggeration of the activity of the pneumogastric nerve, constituting the state of *vagotonus*. Since Nolf's theory was first expounded the new knowledge of the vestibular physiopathology and the study of labyrinthine excitation have thrown a new light on the ætiological discussion of sea-sickness.

It is also now known that a syndrome quite similar to that of sea-sickness in labyrinthics and in individuals seated in a revolving chair, the rapid revolutions of which produce movement of the endolymph in the semicircular canals. Further evidence is furnished by the fact that a warm or cold douche into the ear provokes abnormal movement in the endolymph of the canals and this determines real sea-sickness. Ruttin, at a time when the disturbance of the sea was suppressed, gave a bilateral warm douche: the sea-sickness immediately appeared and continued as long as the douche. Dragotti has recalled attention to the work of Jones, Bárány, and others that deaf mutes in whom the vestibular mechanism is imperfectly developed do not suffer from sea-sickness. Torcelli was one of the first to uphold this theory.

Before pursuing this question further, I consider it opportune to make some brief anatomo-physiological remarks on the semicircular canals. The three osseous semicircular canals, superior, posterior and external, take the form of tubes curved like arched hoops opening into the vestibule, and having an ampullary form near one end. The membranous semicircular canals occupy the interior of the osseous canals, and, although not completely filling them, present the same configuration.

The semicircular canals are filled with endolymph and perilymph, clear, colourless liquids, and in their ampullæ are calcium carbonate crystals (auditory powdered otoconia). In some fish these crystals constitute real stones (otoliths) of three to six centigrammes in weight and represent the auditory organ (V. Nuvoli, *Pidiologia del l'organo uditivo*, Loescher, 1907).

The large otoliths are evidently in relation to the surrounding water in which the fish live, and being supported by water on all sides, lose much of their weight. The otoconium in higher vertebrates comes into direct and immediate contact with the nerve terminals and, when sufficient, excites their sensibility, which is proved to be marvellously exquisite. Further, it cannot be denied, as Nuvoli affirms, that the microscopically crystalline constituents, the otoconia, being more mobile than a single large otolith can excite the nerve terminals in the macula more particularly corresponding to the least movement of the body, and represent a comparative progression of the single otolith.

I leave in this relation the word to Prof. G. Nuvoli, who has eviscerated all the vestibular physiopathology in a recent publication. Above all, he absolutely denies, and in this is in perfect accord with Cron, the hypothesis of Goltz, according to which the disturbances of the endolymph contained in the semicircular canals which depend on the movements of the head in this way provide adequate physiological excitation of the ampullary nerve terminals. On the one side is the capillarity of the membranous canals, and on the other is the density of the endolymphatic fluid which rather resembles mucus. Considering that the osseous canals which, in higher vertebrates contain the membranous canals, in fish are sometimes reduced to simple hooks (gami) which only enclose a small tract of the membranous canals, which thus remains almost free within the osseous capsule or cartilaginous labyrinth, whilst the hook serves exclusively to fix the direction of the canal.

If, then, in fish there is not produced adequate excitation of the ampulla, it naturally cannot be produced in the higher vertebrates. The endolymph merely represents the natural surroundings necessary for the life of the vestibular nerve terminations which were born and live exclusively in water, as above pointed out by Nuvoli.

Goltz's hypothesis, then, accepted for want of a better one, and repeated in all the physiological treatises, is entirely insupportable. According to Nuvoli, the ampullary nerve terminates in a manner precisely opposite to that upheld by Goltz. He affirms that the semicircular canals originated in three planes: two vertical and perpendicular and between them, the third horizontal and perpendicular to the first, and therefore corresponding to the three dimensions of space, are attached to the otolitic vesicle like three soft, flexible handles to a little mobile basket, like a pendulum in the perilymph. In the movements of the head and body the pressure on the otoliths, which, by inertia, are the last to follow the movement, will not be more exclusively and directly from above downwards, since it is not caused solely by the force of gravity, but is felt laterally on the inner surface of the vesicles in a direction opposite to that of the movement itself, and the membranous canal will be stretched. In the other termini the traction will be variously distributed among the three semicircular canals, depending in the direction of their planes and of the movement.

This traction of the semicircular canals provides an adequate physiological stimulus to the ampullary nerve terminals. Every movement of the body and inflexion and rotation of the head will provoke in each vestibule three ampullary sensations of different intensity, according to the different traction in each canal, by the perception of which the direction of the movement can be determined. This determination thus depends on two essential facts, namely, the special anatomical disposition of the three planes, and the varying intensity of the ampullary sensation. The three osseous canals have no other function than that of maintaining the membranous canals in their assigned planes. The otocyst remains the essential element of the whole vestibular apparatus, since it alone can satisfy the needs of the equilibrium and movements of the body, the semicircular canals integrating and perfecting their functions.

Let us now see the anatomical connections between the vestibule and the pneumogastric nerve. From its origin in the lateral sulcus of the bulb to its termination in the diaphragm this nerve furnishes branches to the thoracic and abdominal organs. Its anastomosis with the facial constitutes the auricular nerve of Arnold, with its two branches, one anastomosing with the posterior auricular nerve and the other being distributed to the posterior face of the pavilion and to the postero-inferior wall of the external auditory meatus.

Excitation and hyperæmia of the vestibular apparatus also produce excitation of the vestibular bundle with which it articulates. This vestibular bundle is excited directly by the specific peripheral sensibility of the vestibular apparatus, and indirectly by the general sensibility of the body by means of the cerebello-vestibular fibres which terminate in the nuclei of Deiters and Bechterew.

Experimental results are confirmed clinically, in that the vestibular bundle can easily become suppressed by slight and inadequate stimuli, mechanical, thermal and electric, and that a lesion in it may immediately produce serious oculomotory functional disturbance, with consequent disorientation, which persists as long as the abnormal excitation of the vestibular bundle lasts.

One of these inadequate stimuli is prolonged rotation of the body on its vertical axis. Rotation of the head and body within normal limits represents a normal stimulus for the otolitic vesicle and the semicircular canals which react with a corresponding normal reaction; when, however, the duration and speed of the rotation are excessive, as produced in a revolving chair, the stimuli, becoming inadequate, induce disturbance of the vestibular

apparatus, and consequently of the vestibular bundle with which it articulates. This immediately produces a disturbance of equilibrium even to falling, impossibility of walking, vertigo, nystagmus, nausea and vomiting. Similar phenomena occur when a current of air or of warm or cold water enters the auditory canal, causing excessive heating or cooling of the vestibular terminations, or when the poles of a galvanic current are placed within the tragus of the ear or on the mastoid process, inadequately exciting these terminations.

Conclusions.

Accepting a modification of Nolf's theory, I conclude that sea-sickness is a functional disturbance due to the hyperæmia of the vestibular apparatus, produced by the constant changes in the position of the body on the ship in movement (movements which have an opposite direction in pitching and rolling) by which at first the semicircular canals and the endolymphatic liquid simultaneously follow the movements of the body, and that when they have a movement in the opposite direction the endolymphatic liquid continues to be carried in the direction produced by the first impulse and then goes inversely to the movements of the semicircular canals, which follow all the movements of the body. In this way the endolymph is made to impinge on the ampullæ of the semicircular canals, producing vertigo.

Movements of the ship will excite different semicircular canals, especially of the superior and posterior canals (rolling and pitching). Excitation and hyperæmia of the vestibular apparatus produce a reflex vertigo with exaggeration of the activity of the pneumogastric nerve (vagotonic state). In these conditions the best remedies are those which act as sedatives to the vagus, and tampons producing ischæmia introduced into the external auditory meatus.

Numerous experiences have produced satisfactory results, which have been confirmed by means of criteria *ex juvantibus* the correctness of the ætiological theory.

Postscript.—Having submitted the preceding publication in homage to the great Italian clinician, Augusto Murri, he had the courtesy to reply in these terms:—

"The argument is as obscure as it is ancient, but your better knowledge and perspicacious observations have radiated much of the darkness which surrounds this phenomenon so common and so well known, though still mysterious. The importance of the vestibular nerves, of the vagus, of the semicircular canals and of the otolith has been clearly put. But the phenomenon of the equilibrium of the body is very complex. In addition to the canals, the vestibule and the vagus, there are at least two other phenomena yet to be explored: our consciousness of equilibrium lost or menaced, and the faculty of reacquiring it voluntarily. It is true that all this is physiology of the whole encephalon and not merely special to sea-sickness, but is there any sea-sickness without the cerebrum and cerebellum? I cite this that light may be thrown on it, not to cast doubt on the pathogenesis. . . ."

These observations will induce me to prosecute further researches, during which notice will be taken of Prof. Trocello's work.

Trocello (*Annali di Medicina Navale e Coloniale*, Nov.-Dec., 1916) treats at length the pathogenesis and ætiology of sea-sickness and concludes that the disturbances are not be be considered merely as labyrinthine vertigo.

It is a vertigo of general kinæsthesia in which the vestibule also appears to play some part. Vertigo is a phenomenon of consciousness and, in the case of sea-sickness, it is provoked by disturbance of the automatic centres of equilibrium only in that it is averted from the superior psychic centres. The cause of the kinæsthetic vertigo, according to Trocello, is always to be sought for in passive movements of the extended body, acutely, in a continuous and prolonged manner, to determine static and dynamic equilibrium; movements which occur in different planes, which are unusual for the subject and which possess accessory characters, such as brusque and fleeting vibration and interruption.

The conclusions of Trocello thus answer Prof. Murri's observations, and I agree that sea-sickness is a more general phenomenon. Nevertheless, it appears to me that sea-sickness is chiefly a vestibular vertigo complicated by vagus irritation. This is, however, not to exclude the insufficiency of the automatic centres of equilibrium (Trocello) which, without doubt, have a value not negligible, for the reason acutely stressed by Murri that sea-sickness cannot exist without the cerebrum and cerebellum.

In any case the practical result remains that medicaments which exert a depressant action on vagus tone and on the vestibule give the most brilliant results, and this is concordant with Trocello.

My experience and observations confirm the hypothesis already set forth, to which may be added insufficiency of the automatic centres of equilibrium.

Geographical Distribution of the Milkweed Flagellate, Herpetomonas elmassiani (*Migone*) (Francis O. Holmes, *Phytopathology*, May, 1925).—*Herpetomonas elmassiani* (Migone), previously known to occur in Maryland, was found to be present in the latex of milkweeds (*Asclepias syriaca* L.) as far north on the Atlantic coast as the northern boundary of New Jersey within a few miles of the Hudson River. Points in New York State and in Massachusetts were examined without positive results.

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SPIROCHÆTAL PULMONARY GANGRENE.

BRONCHIAL or pulmonary spirochætal infection was first described by Castellani in Ceylon in 1905. These findings were soon abundantly confirmed by many authorities and from many parts of the world. It has now been found not only in Ceylon, but also in India, China and Indo-China, the Philippine Islands, North and Equatorial Africa, being especially common in the Sudan, in the West Indies and in America. It has recently been encountered in various parts of Europe, mainly in the Balkans, in Switzerland, Italy, France and England. It would thus appear that the disease has quite a cosmopolitan distribution.

The brunt of the affection has hitherto been considered to fall on the bronchi, a form of bronchitis resulting, which may be acute, subacute or chronic in type. The acute type is often mistaken for influenza and malaria. Examination of the sputum for the presence of Pfeiffer's bacillus will distinguish the affection from influenza, and the examination of the blood for plasmodia will differentiate malaria. In the subacute and chronic types the presence of blood in the expectoration is so prominent a symptom that Violle termed the affection "bronchite sanglante." It is generally diagnosed in the first instance as phthisis and only after repeated negative examination of the sputum for tubercle bacilli and the recognition of *Spirochæta bronchialis*, which is generally present in very large numbers, is the correct diagnosis arrived at. From endemic hæmoptysis bronchial spirochætosis is readily distinguished by the absence of ova of *Paragonimus ringeri* Cobbold on examination of the sputum.

The causal organism was termed *Spirochæta bronchialis* by Castellani, and both he and Fantham consider it to be a separate species and quite distinct from the several varieties of spirochæta encountered in the mouth, either in health or disease. This view has lately been challenged, especially with respect to the organism found in cases of pulmonary spirochætosis where gangrene of the lung is apt to supervene, and evidence is now accumulating that pulmonary gangrene may be caused by spirochætes and fusiform bacilli aspirated from an unclean mouth, and that it may be prevented by proper oral measures, and the causal organisms can readily be found in the washed sputum. The ætiologic relationship of spirochætes and fusiform bacilli to pulmonary gangrene is evidenced not only by the predominance of these organisms in early gangrenous areas, but also by the fact that gangrene with death in a few days was produced in guinea-pigs by the injection into traumatized tissues of material from pyorrhœa alveolaris, dental caries, pulmonary gangrene and Vincent's angina containing innumerable Vincent spirochætes and fusiform bacilli. The relationship of oral spirochætosis to pulmonary gangrene is emphasized by the production in the rabbit of pleuropulmonary gangrene following the intrabronchial injection of material from dental caries containing innumerable Vincent spirochætes and fusiform bacilli.

In the course of two years Kline and Berger (*Journ. Amer. Med. Assoc.*, November 7, 1925) observed sixteen cases of pulmonary spirochætosis at the Mount Sinai Hospital in Cleveland, and consider that this number gives a better idea of the incidence of this condition than the fact that only

fifty-two cases have thus far been recorded in the literature of the United States. In five of the cases in which definite gangrenous necrosis with cavitation was present, arsphenamin treatment apparently prevented death and resulted in practically complete disappearance of symptoms. Five cases in which there was extensive pulmonary or pleuropulmonary gangrene, and in which no treatment was given or treatment when the patients were moribund, resulted unfavourably. In five cases in which there were less severe acute pulmonary lesions arsphenamin treatment resulted in prompt cure.

The onset of pulmonary gangrene in the course of any respiratory condition should then be suspected when the sputum becomes brown and foul-smelling, and there is an increase in the severity of the existing signs and symptoms. A diagnosis before any appreciable pulmonary destruction has occurred may be made by finding Vincent spirochætes and fusiform bacilli in the sputum after careful washing.

Spirochætal pulmonary gangrene is a distinct entity and can be prevented by eradicating the primary oral focus. It apparently develops as a result of the aspiration of spirochætes and fusiform bacilli from the oral cavity. It may be engrafted on any acute or chronic pulmonary condition, but is usually unrecognized, principally because its symptoms, although characteristic, are attributed to the primary disease. It is a grave complication, and if untreated is frequently the cause of death. Arsphenamin therapy is apparently a specific in this as in other spirochætal infections.

F. E. T.

Annotations.

Plague and the Regulation of Numbers in Wild Animals (C. S. Elton, *Journal of Hygiene*, October, 1925).—A short account is given of the occurrence of plague in wild mammals other than "domestic" rats and mice. Enough is now known to show that such epidemics are of great practical importance. The method by which most rodents regulate their numbers is as follows: increase in numbers over several years up to a point at which an epidemic of some sort occurs, which kills off a large proportion of the population. Increase then takes place again, and is followed by another epidemic, and so on indefinitely. These periodic fluctuations are probably controlled by widespread climatic fluctuations, the best evidence for this being that in certain cases the former run synchronously in widely separated countries. There appears to be a dominant short period in fluctuation of three to four years, and a large movement of period ten to eleven years, both in North America and Europe. The fact that the eleven-year-old sun-spot cycle roughly corresponds with the larger movement is significant.

The data available from Eastern Asia suggest that there, too, small mammals fluctuate periodically in numbers, and with similar periods to those of North America and Europe. There is also some evidence that the maxima of the ten to eleven-year fluctuations coincide in Eastern Asia and in North America, just as those of the three to four-year period coincide in North Canada, Greenland and Norway. Evidence is given that the plague marmot (*Arctomys bobac*), and other rodents carrying plague, are liable to these fluctuations. If this proves to be true it may be possible, when fuller data are available, to forecast with some accuracy the years of epidemics among these animals, and if this can be done we shall have some means of gauging the likelihood of the occurrence of plague outbreaks in the human population of those regions. The available data are admittedly fragmentary, but it is probable that between the years 1931 and 1934 epidemics among *A. bobac* in Transbaikalia and Mongolia will be severe, and that these events will lead to an increase of plague mortality in man.

Remarks on a New Flocculation Reaction for the Serodiagnosis of Malignant Disease (H. J. B. Fry, *Brit. Med. Journ.*, February 4, 1925).—The preparation of an antigen and its mode of employment in a simple flocculation reaction for the diagnosis of malignant disease are described. Tested in 500 cases of both malignant and non-malignant conditions a correct result was obtained in 75 per cent. Except in one case uniformly negative results were obtained in healthy persons. In the absence of malignant disease flocculation seldom occurs in syphilitic conditions, but a control Wassermann test is advisable. In acute febrile conditions, such as sepsis and tuberculosis, positive flocculation may be obtained.

The Relation of Herpetomonas elmassiani (*Migone*) *to its Plant and Insect Hosts* (Francis O. Holmes, *Biological Bulletin*, November, 1925).—Histological studies of the milkweed host of the flagellate *Herpetomonas elmassiani* (Migone) showed that the organisms were confined to the latex system, in which they were intracellular but not intracytoplasmic. The latex is secreted into the general cell vacuole of the latex duct, and it is in this that the organisms were found. No other cells or parts of cells were found to be penetrated. During the early part of the summer one or a very few latex cells in a plant were sometimes infected, for in *Asclepias* the original latex cells of the embryo never fuse. Because of this condition occasional localized infections appeared, in which a few leaves of the infected plant were found to be free from organisms. The flagellates of *Oncopeltus fasciatus* (Dall), a red and black hemipterous insect suspected of being the insect host of *H. elmassiani* (Migone), were found to inhabit the three-lobed thoracic salivary gland. In the gland these were definitely localized, colonizing only the dorsal and anterior lobes.

Leukoplakia Buccalis (Howard Fox, M.D., *Journal of the American Medical Association*, November 14, 1925).—Leukoplakia occurs chiefly in men, especially of middle age. It is rare in women and in full-blooded negroes. The essential cause of leukoplakia is unknown. Syphilis acts as a predisposing cause in the majority of cases. In a minority of cases such a relationship can be definitely excluded. Various sources of local irritation act as predisposing causes, including tobacco, alcohol, rough teeth, and gastro-intestinal disturbances. Of these, tobacco is undoubtedly the most important. Leukoplakia is a frequent forerunner of cancer, though it may exist for years or decades before the appearance of any malignant change. In the treatment of leukoplakia, prophylaxis is all important. The permanent cure of leukoplakia is difficult, the best agent for this purpose being apparently radium or the actual cautery.

A Bacillus of the Paratyphoid Group (Howard Anderson McCordock, *Bulletin of the Johns Hopkins Hospital*, December, 1925).—A bacillus of the paratyphoid group, apparently unencountered by previous investigators, is reported. Culturally it is similar to the other paratyphoids, but can be differentiated from them by its low avidity for rhamnose, failing to ferment this sugar in 24 hours, and the absence, or only slight production, of gas in all carbohydrates except xylose. Agglutination tests leave no doubt concerning its individuality, and agglutinin absorptions sharply separate it from the other paratyphoid types. The organism is pathogenic for mice, rabbits, guinea-pigs, but especially for rats. For the bacillus here described the author proposes the name *Salmonella muriotitis*.

Current Literature.

The Indian Medical Gazette. November, 1925.

A Note on the Value of Iodine Intravenously in the Treatment of Influenza (C. P. V. Shunker).—During the month of June, 1925, there occurred at the Central Jail, Bellary, an epidemic of influenza; sixty-six cases were admitted to hospital. All the cases were of the typical acute catarrhal variety. Twelve cases were complicated by lung conditions, pleuro-pneumonia or broncho-pneumonia. There were no deaths. Iodine used intravenously proved beneficial in the severe cases and brought about a marked improvement in the general condition of the patients in a short time. There is no danger attached to the method if the usual precautions are taken.

The Mosquito Factor in the Malaria of Assam Tea Gardens (C. Strickland).—Of the known malaria carriers which occur in Assam, *Anopheles funestus* and *A. aconitus*, represented in the paddy-fields, are very dangerous; probably during the rains *A. culicifacies* breeding in pools of pure water is also of danger; *A. maculatus*, breeding in spring water, cannot on present evidence be incriminated with doing much harm; *A. umbrosus* lurks in all undrained jungle, which should be viewed with great suspicion, and *A. jeyporiensis* takes no unimportant part in the causation of the disease. Of the measures for mosquito control, screening houses and especially clubs seems to be the most desirable, and an attempt should be made to sterilize the blood of children.

The Treatment of Malaria with Peracrina 303 (Wm. Fletcher).—Peracrina 303 is a chemical compound of acriflavine with a specific albuminate. The pills consist of a mass of yeast cells and a little starch, stained with a yellow dye, weighing about 10 gr. each. It is impracticable to administer peracrina for a long period and in the large doses recommended by the makers, and it is also too expensive for general use. The clinical tests made in Kuala Lumpur did not show that this product had any effect upon malaria parasites. The parasites may increase during treatment with peracrina and it is dangerous to employ it in the place of quinine.

Reviews.

An Elementary Course in Tropical Hygiene. Part I. By Mary G. Blacklock, M.B., B.Sc., D.T.M., Lady Medical Officer, West African Medical Service, with a Preface by Andrew Balfour, C.B., C.M.G., M.D., B.Sc., F.R.C.P. Published for the Tropical Diseases Bureau by John Bale, Sons and Danielsson, Ltd., London. 1926. Price 1s. net.

This booklet of forty-four pages is intended to form the first part of a school primer on tropical hygiene, and is written in the simplest language so as to be adapted to the needs of the child's mind, and the lessons are driven home by the presence of a few simple but arresting drawings of birds, flies, mosquitoes, and rats. After a few introductory lessons, the instruction is carried on in the shape of a story, which should serve also to keep the children interested. Dr. Blacklock has thoroughly succeeded in conveying the basic facts of tropical hygiene in a manner which should thoroughly appeal to her young listeners.

Department of Health Malaria Research Unit, Haifa, Annual Report, 1923.

The Malaria Research Unit of the Department of Health at Haifa, which is maintained by the American Joint Distribution Committee in co-operation with the Government of Palestine, has issued this excellent Annual Report, beautifully printed, well illustrated, and provided with good maps. The close correspondence in Palestine between the calendar year and the malaria season makes it convenient to adopt the former as the basis for purposes of control, compilation

of records, statistics and reports. The first part of this report deals with the control demonstrations, which enabled the Unit to obtain a considerable amount of useful information as to the prevalence of malaria in different parts of the country, its ætiology, nature of breeding-places, types of anopheles mosquitoes, &c., as well as serving as an excellent means of practical education of the public at large in the value of malaria control. The second and third parts deal with the permanent drainage work carried out by the Unit or by other agencies with Unit supervision, and with the work of the laboratory. We should be glad to see other annual reports reach the high standard of this one.

HANDBOOK OF TROPICAL DISEASES. By Many Writers. Edited by Carl Mense. Vol. I. 3rd Edition. 1924. Barth, Leipzic.

This magnificent volume constitutes the first volume of Prof. Mense's Tropical Diseases, which has now reached its third edition. It deals fully and systematically with arthropods and the diseases which they transmit, from the pen of Dr. Eysel, of Cassell, and with hæmatology as applied to tropical medicine, from the able pen of Dr. Victor Schilling, of Berlin. So well and thoroughly is the work done that this handbook may be looked upon as the authoritative German work on tropical diseases. Each section contains an extensive bibliography of the subject, in which it is gratifying to note that references to the English literature figure quite extensively. The illustrations, which number 341, along with twelve plates, of which five are coloured, are beautifully executed and constitute quite a feature of the work. A copious subject index completes this very fine and exhaustive treatise.

BATS, MOSQUITOES, AND DOLLARS. By A. R. Campbell, M.D. 1925. The Stratford Coy., Boston, Mass., U.S.A.

This curiously-named book contains some curious reading. The author, Dr. A. R. Campbell, claims to have made an intimate study of malaria, having limited his practice to that disease and typhoid fever. The book is divided into four parts. Part I deals with bats, mosquitoes, and dollars, and gives the title to the work. It discusses *seriatim* four statements or, as the author calls them, allegations, namely: (1) That the malarial mosquito is one of the greatest enemies of mankind. (2) That the bat is one of man's best friends, because it so relentlessly destroys the malarial mosquito, that insect being its natural and principal food. (3) That we can build a home for bats[1] in a scientific manner to meet the requirements of their most singular habits, and one which they will inhabit: a home where, being protected from their natural enemies, they will increase in countless numbers and eradicate the malaria in its vicinity; and (4) That each bat roost, in addition to its great hygienic value, is in itself a little gold mine, by reason of the cash obtained from the natural high-grade fertilizer, guano, which it will certainly produce. Part II deals with dragon-flies. Part III with bed-bugs and small-pox and the eradication of small-pox by other means than vaccination. Part IV describes the author's views on the functions of the spleen, whilst a glossary of technical terms used, couched in the simplest possible phraseology, indicates that the author had his eye on the general, rather than the medical, public when writing this book.

[1] A photograph of a bat tower, or roost, appeared in our issue of November 2, 1925.

MEDICAL EDUCATION. A COMPARATIVE STUDY. By Abraham Flexner. The Macmillan Company, New York. 1925. Price $2.50.

In this comparative study of 334 pages, Mr. Abraham Flexner has given a comprehensive survey of the state of medical education at the present day in the various countries of Europe, in Canada and the United States, together with a critical review of its progress during the last fifteen years. Mr. Flexner takes a wide view of his subject, and discusses in turn general education, the basic sciences, the curriculum, the laboratory sciences, the clinics, and the institutes for medical research. A chapter on the important question of costs is also included. This volume is the more welcome as so little has been written on this subject in English, and so much information has been gathered together in its pages, that it is absolutely essential to all who are interested in the subject of medical education, whether from the point of view of educational methods or concerned with the organization of medical schools in any part of the world.

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON HEALTH PROBLEMS IN TROPICAL AMERICA (held at Kingston, Jamaica, B.W.I., July 22 to August 1, 1924). 1924. Boston, Massachusetts, The United Fruit Company.

The volume is a record of the proceedings of the International Conference on Health Problems in Tropical America, which met at Kingston, Jamaica, July 22 to August 1, 1924, by the invitation and under the auspices of the Medical Department of the United Fruit Company. Delegates were invited to represent universities, medical societies, health organizations and governments, and the list includes many names eminent in tropical medicine, both from Europe and America. Following the scientific sections at Kingston, the members of the Conference were given an opportunity to inspect and study the medical and sanitary work of the United Fruit Company in its divisions in Honduras, Guatemala, Costa Rica, Panama and Colombia. Following an address of welcome in glowing terms by Dr. Deeks, the General Manager of the Medical Department of the United Fruit Company, are seventy papers contributed by the members of the Conference. These seventy papers comprise a wide and comprehensive discussion of almost every aspect of tropical medicine and hygiene, each by an acknowledged authority in his subject. They afford much valuable information which no up-to-date practitioner of tropical medicine can afford to overlook.

Original Communications.

ANATOMICAL OBSERVATIONS ON THE YELLOW FEVER PROBLEM IN AFRICA.

By Prof. W. H. HOFFMANN,
Habana, Cuba.

SOME weeks ago, through the kindness of Dr. Young, I received the kidneys of four cases of suspicious yellow fever from Accra, Gold Coast Colony, West Africa.

The official reports of the recent epidemics mention twenty-six cases with eighteen deaths for 1923, and eight cases with seven deaths for 1924.

The organs reached me in a good condition as it is quite easy to send specimens of about 1 c.c. in size in a 10 per cent. solution of formalin by sample post in the small laboratory tubes generally used for the transport of fæces or blood samples.

In the anatomical material of twenty-eight cases of yellow fever I studied last year[1] I found the presence of casts of lime-salts in the kidney in twenty-four cases. My observations have been confirmed in a recent epidemic in San Salvador. In my opinion this lesion is very characteristic of yellow fever. So I was very much interested in studying the kidneys of these West African cases.

The four cases from Accra uniformly show a certain degree of parenchymatous nephritis with formation of hyaline casts often stained by bile pigment, especially in the secretory part of the tubular system.

The severe nephritic degeneration and the hæmorrhages and blood-casts, which are characteristic for yellow fever, were not present and I did not find any necrotic desquamation of the epithelium nor limecasts, which, in my opinion, are produced very acutely by infiltration of the dead cells with calcareous substances under the action of the specific powerful toxins of yellow fever, but in no other disease. The lime-casts would probably not be absent in all the four cases if they were yellow fever.

Fig. 2 shows the limecasts in a typical yellow fever case. Fig. 1 shows the kidney of one of the West African cases. The difference is evident.

After my study of the four cases from Africa I think that the lesions in the kidney do not correspond to those of yellow fever.

In one case I found many hæmoglobin-casts. This would suggest a case of a hæmoglobinuric fever rather than of yellow fever, which does not produce hæmoglobinuria.

Recently I have seen cases of a fatal disease which, even to an expert like Guiteras, clinically seemed similar to yellow fever. But Cuba has been free from yellow fever for almost 20 years. I had the opportunity of making the anatomical study of such cases, and was absolutely sure that they could not be yellow fever. An examination of the blood showed that the disease was caused by a severe infection with the parasites of subtertian malaria. The parasites were not only present in nearly all the red cells, but generally there were two or three of them.

Neither clinically nor anatomically is it easy to make the diagnosis of yellow fever in sporadic cases as in West Africa with absolute security, and especially to differentiate them from the hæmoglobinuric cases. I think it will often be impossible without the cultivation of *Leptospira icteroides* and the specific immunity reactions.

There is no doubt that a clinical picture similar to yellow fever in certain cases may be produced by malignant malarial infection, perhaps also by

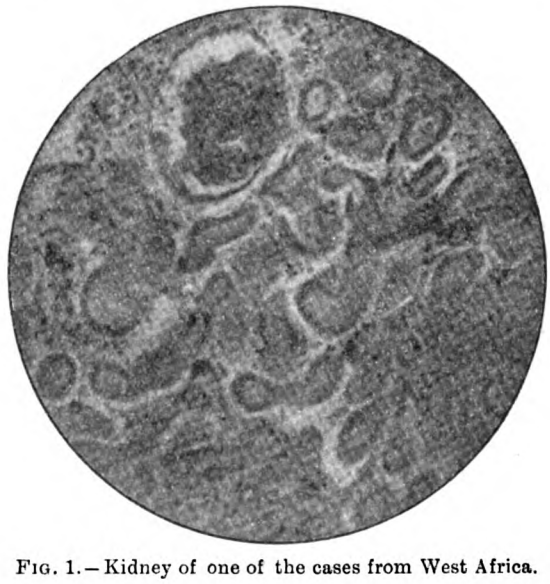


FIG. 1.—Kidney of one of the cases from West Africa.



FIG. 2.—Kidney of a case of yellow fever, showing the lime casts.

[1] W. H. Hoffmann: "The Histopathology of Yellow Fever," *Journal of Tropical Medicine and Hygiene*, 1924, No. 17, p. 235.

spirochætal infections or even by some still unknown leptospiral infections.

I know that this study must be necessarily incomplete, as the material and the information at my disposal are limited. After the anatomical study of these four cases I cannot convince myself that they are true yellow fever cases.

My arguments are of rather a negative character. What we really want is a positive proof—which I lack—that endemic yellow fever still exists in West Africa, because this alone will allow us to take the necessary international measures for its immediate control, which are indispensable, if it is present in some form or other.

This question is of such overwhelming importance for the epidemiological safety of the whole world, especially for America, that it seemed justifiable to contribute with such an incomplete observation to the discussion of the problem.

MALARIA IN WEST AFRICA IN 1893.

By G. Rome Hall, M.D.

The first acquaintance with this disease was made by the writer in 1893 at Lagos, West Africa, in the Colonial Medical Service. Although at that time Laveran had designated the mosquito as the greatest factor in its production, these views had not yet authoritative sanction: the School of Tropical Medicine had not been founded, and the exact link between the insect and the disease had not been established. It was about four years after this that the present scientific attitude to the disease began to develop.

At that time the new medical man did well to listen with respect to the views of the Old Coasters, their laymen experiences were worth studying. It cannot be said that the first trained medical men from the above school extended the same courteous hearing to those of their own profession who had been treating the disease not without skill, and not without a large measure of clinical success, of the nature of instinctive action that even in this day puts the general practitioner of thirty years' experience ahead of the man fresh from the schools.

You were told when you came ashore that your expectation of life was seven years; very few men then came out after thirty for the first time, the Colonial Office rarely sent anyone under 24. The white officials then served under a twelve months' term ashore and six leave; at that time you were fortunate if you did not spend over seven weeks over the two voyages. The commercial men were usually under a three years' agreement. Another bad point was that many were far too young in age, even under 20. The missionaries came out for a longer period, but generally had the advantage of a medical examination first; this was not the constant routine with the commercial men, but if the former came out at their own expense they were excused a proper standard. The mining industry had not then begun: perhaps a dozen white men were at Tarquah, on the Gold Coast.

Early Ideas of the Disease.

The name itself, the disease due to breathing evil airs, shows that for generations it had been associated with the odours of decomposition of certain localities, especially those of the swamplands. It had become accepted that if a man went ashore for a night or two at Sierra Leone, on the way out, then about a week from Lagos for the mail boats, that he would probably develop fever within a few days of landing. When there had not been this element of risk it was considered a certainty that fever, then a synonym for malaria, would show very soon if he did not protect himself against the sun by the umbrella at certain hours, and the helmet between eight and five. The former observation caused many old coasters to start taking quinine at Las Palmas in the Canaries, then a week from Sierra Leone.

This disease had been specially studied for over two hundred years in the West Indies; at least three peculiar facts stood out there. In the Guianas, with topographical characteristics apparently the same as West Africa, it was possible for children born of European parentage to grow up to maturity on the West Coast a very few years of early life was possible, and that not on the coastline. At a Basle mission in the grasslands behind Accra, and at a higher altitude than the coast, four children had been born, who had lived to go home at an early age. Also, exercise could be taken in the West Indies without harm that was disastrous on the Coast; cricket, played from early afternoon in the former, was impossible till after 4 p.m. But in Kumassi such was possible; it has an altitude of over 800 feet.

In the West Indian Islands it was noted how altitudes for many years free from malaria would suddenly develop it. In the present day you would look for the arrival of previously absent anophilinæ, or the advent of actively infected persons, if the former had been there before. Another peculiarity was that in certain observed localities it was stated that the disease could not cross running water: it occurred on one side of a river, and not upon the other. For many years Axim Fort, on the Gold Coast, had the reputation of being one of the healthiest official stations, and Kwitta, at the other end, about the worst. The fort stands on a small promontory jutting out into the sea, swept by the prevailing breeze coming straight in off the blue water; the small swamp on the landward side was some sixty feet below, the drift in the harmattan land breeze was into the bay. But Kwitta was on a sandspit some twenty miles long, with swamps some miles deep behind it, and the prevailing south-west wind came over them on to the town. Personally mosquitoes gave me but little trouble, for four spells on the Gold Coast I slept without curtains, but only one night there: a specially malignant breed existed, marked both for pertinacity and size.

Other points had been noticed. That the devitalized white man who had got over his seasoning

ver, as the natives called it, was a much better roposition to his employers than the newcomer ith his European vigour unspoilt. In fact, if the mer was a specially fine specimen of manhood, e was regarded as more likely to have a malignant ttack. The equivalent experience was well known ears ago on board ship, when the finest men would ddenly die from pneumonia, being overboard ithin 48 hours of being ill. The reason was the me: being of high resistance they stood up and pt on duty through the early stages of the disease til they crashed. In expeditions where white en had been employed it had been recognized that e Guardsman type was nowhere in ultimate resist-nce, when ill, to the short stocky man of good est physique.

It was considered that service in India and alaya did not give a man a better chance in West frica, rather the reverse; the exception was that e old Dutch official stood the change well. The robability was, we know now, that the man of the mer experience was not only devitalized, but had enign infection, whereas the latter was a survivor om the malignant infection at Batavia and neigh-ouring places. The Dutchman was reputed also o study himself as regards exposure to the sun, voiding it as much as possible, and travelling at ight by boat as much as he could when he had to ass between his coast stations.

This state of devitalization was a very real con-ition of health; to a definite extent you had to alter your constitution. A certain degree of anæmia came on: it was a saying that West Africa bleached you, but did not bronze you. From want of mus-ular exertion, and, we know now, the atonicity aused by latent infection, there was a softening of issue generally, but one result was fewer waste roducts except on exertion to cause trouble if atabolism went wrong. Cardiac action shared in his want of tone by irritability on exertion, he respiration became shallower, easily passing into uickened arhythm. The diurnal health variation f temperature was more marked than at home: p to 99·2 was normal in the sun before profuse erspiration came on. The skin in health was lways moist, with visible perspiration on exertion, r out of the breeze in the daytime. In my case it ever ceased until the temperature sank below 9° F. The skin became paler, the epidermis hinner, and the glands more patent. This pro-use transudation on exertion meant that a man went about with a cold water jacket around him in the shape of a skin under blood-heat; in my own ase the skin often registered three degrees less than the mouth, even five on special exertion in bad health. But these remarks only refer to those who had undergone a change of constitution; until you had done so you had not become acclimatized. When these changes had occurred there was rela-tive safety; a man without a minor enlargement of the spleen was not safe. An old coaster's welcome to a newcomer was: "Well, we will know in six months if we are going to keep you." This change might be arrived at in two months if there was a severe seasoning fever within that time; if in reasonable health you might last out nine months, as in my own case.

When that time arrived the profound change that had occurred in metabolism was shown by the fact in most cases that the normal motion had ceased to be passed in rouleaux, but without shape and semi-fluid; this was ordinary in the native. The urine on standing a short time became alkaline, at any time it tended to visible formation of phos-phates, and sometimes was eliminated alkaline, remaining so at home occasionally. It is believed that these remarks do not of necessity hold good in coast life now: reasons will be given further on.

The Social Effects of Malaria.

As has been shown over and over again by reports from the School of Tropical Medicine, the whole development of the moist tropics was held up by this disease, by its effects on both Europeans and natives alike. We know now that there were two other fevers often mistaken for varieties of malaria, or concurrent factors in its incidence—sun and yellow fever. A person who has suffered severe sun exposure, either acute, or slighter and more chronic, has his resistance to other infections, acute or latent, greatly reduced: this was well recognized as a clinical fact. Sun fever is personally regarded as a breakdown in the processes of blood-albumin metabolism, that such stops short at the first stage of albuminoses, these accumulating in toxic quan-tities. When it is remembered that albumins *in vitro* coagulate at 140, and that the solar heat is usually at midday 155 at least, and this in a super-moist atmosphere, it is easily seen that resistance must be kept specially high. The most marked feature is that the temperature goes up, and keeps up with minor fluctuations, the cerebral disturb-ance is more marked than in malaria, and the skin has a constant pungent dry heat, perhaps for days. Any attempt to force it into action with sudorifics is hurtful: diuretics and slight stimulation seem to give the best results. It is as if the morbid pro-ducts formed have to burn out before the secretory action of the skin returns.

The other disease was yellow fever: in the early nineties it was regarded as a malignant form of malaria. When men who had seen this disease in the West Indies began to serve in West Africa, doubts as to this diagnosis began to be made, but the older view was strenuously upheld by the execu-tive. It fell to my lot to report a case at Cape Coast, where it constantly occurred, in 1903, to have my diagnosis repudiated by those who had never seen the case. The result was that my report was sent to the Colonial Office, my statement being that there was no disease more amenable to preven-tive measures, if recognized. Although we were then told that it was a disease originating in the West Indies, statements made by my native dis-penser led me to report it as endemic in the West African bush. My attitude was justified when the

Commission reported some three years after that these terrible exacerbations of disease were yellow fever, and that it was also endemic: also when a request was made by the Tropical Section of the B.M.A. annual meeting in 1911 for my views on the subject.

The incidence and relationship of blackwater fever to malaria was gone into by me in an article on " The Metabolism of Blackwater Fever " in the April number, 1923, *Journal of Tropical Medicine*.

Owing to Lagos being on a small island, and burials perforce local, it was possible to obtain some information as to the native death-rate, as well as that of Europeans. There were no accurate means of obtaining the percentage rate amongst the latter, but that among the natives in the seven years ending 1893 appeared to be about 40 per thousand, pretty much that of England before the days of the modern science of medicine. 1894 was a bad year, starting with a burst of yellow fever, as we now know it to have been, 31 deaths occurred out of an estimated white population of about 150. A comparison of the deaths for the seven years previous showed that the Germans and French died off at twice the rate of the British; the former had not attained to the tropical instinct, there was decided evidence in Duala in 1915 that they had been apt learners. For both these nations the hours of work were far too long, there was absence of exercise, and in the evening lager beer in the one case, wine in the other, and other social activities, were not conducive to the retaining of a high resistance.

Soon after the completion of the war a Committee sat on the Gold Coast to review the health of the Europeans, statistics were compiled for about twenty-one years on either side of 1897. This date coincided both with the development of tropical medical science and with the influx of Europeans to the Gold Coast owing to the mining and other industries. For a term of twenty-one years prior to that date the mortality for the Gold Coast was 75 per thousand a year; for the same time afterwards it was 18, about an Indian rate. Since then it has improved, having been down to 12 per thousand a year. These figures need criticism to obtain a fuller understanding. They refer to generally picked lives, passed as fit to come out, and to early manhood or womanhood, and to early middle age. Invalids, either of chronic variety, or convalescents after grave illnesses, are sent away to recuperate. In 1893 there were perhaps 200 white people in the Gold Coast; now there are over 2,000, half of whom live in the healthy upland zone, where perhaps only a dozen lived before 1897.

Alteration in Methods of Life.

My first voyage out gives some idea of the stage of civilization existing. A man who did not possess scholastic or other resources regarded service there as a variation of purgatory that would stand him in good stead in the future. The commercial men and the missionaries were a little better off; not so many of them had to live isolated lives as the officials. Not that two white men in a stati were usually better off than one: general inco patibility, or climatic neurasthenia, often preclud friendliness.

The ship was a mail steamer, saloon over t stern, cabins opening direct into it, one bath for to thirty passengers. Oil lamps in the cabins, electricity, no fans, no ice, and therefore limi variety in rations. No sick quarters for passeng or crew; that did not come for some years aft Cabins of about 400 cubic feet, holding on occasi four people, with practically no ventilation exc the ship was moving; even then the lattice arran ment might face the wrong way.

On shore the white men's quarters were ran away from the proximity of native huts; the G man researches in the Cameroons showed eve native child up to four at least an acute dan centre for malarial infection. Where the old fo had reasonable isolation they had danger cent in the storage of water in cisterns; into these rain water ran through uncovered entrances. T first bungalow erected with a " tin " roof was t old cable house at Accra; it obtained a very b record for health. On one occasion there were fi men resident; one died, and another was post by from the cable ship in the roads. He and t others died within two weeks, making one survi out of five. Iron rain-water cisterns had been su plied with unprotected entrances, the water falli into them from the unconnected spouts. Elmi had also a bad repute; the Mission had the us cisterns, and the Castle ones that locked, but whi were open often two half-hours a day. Cape Co was a hopeless hygienic problem until a standa cistern was brought in. The natives stored wat in huge jars sunk in the ground; these were neve emptied from year's end to year's end. Also, very large number of the native houses had met gutters; these inevitably sagged. No nati mechanic believes in accuracy for its own sak they were breeding grounds even in harmatt weather if there was condensation moisture. Ca Coast added on two other elements of trouble, ha shale and quartzite ground soaking in heat all t day; on radiation this was blanketed down by t super moist ground stratum of the air. There we records sometimes of weeks with only six degre variation between maximum and minimum shad Also, in ground of this formation, the town sprea ing over several hills, there were many pockets the hillsides filling with moisture in the rains.

There is one official record of a European infant company being sent there nearly a hundred yea ago; their women and children accompanied them one survived at the end of a year.

If housing was bad, recreation was in the sam position, pretty much that of the early Victoria era at home. There were rarely sufficient Eur peans in a station to form even a cricket team There was one at Accra, also tennis there and Cape Coast and Saltpond. There was no club: th Accra one was founded in 1897. Very rarely di

portunities exist for hunting or fishing. Golf as unknown.

Feeding was so defective that it is no wonder a ge amount of alcohol was consumed; beer was t considered to be beneficial. Champagne was e only wine drunk except after illness: it cer- inly had a rallying effect when a man was fatigued a day's exertion in the bush that nothing else d, and in cases of acute exhaustion was often sidered to ward off the development of black- ter fever. The cost of transport prohibited soda ter in the bush, and sparklets had not come in. was unknown.

For years the old coasters had acted on the prin- le of native food in the morning and European d at night: it was a case of survival of the fittest. now know that explanation was the vitamin-con- t of the former, and its grave absence in the ter as then available; the staple native food was undnut or palm oil soup.

The natives make the latter from the whole fruit; is a drupe, with the vitamin in the pericarp, it is t in the oil made from the kernel, and the sub- tute butters at home will be good or not accord- to which oil they are made from. The ground- t makes a soup like peasoup, the kernels, with ir thin outer skin, are roasted whole and ground , the vitamin is thus preserved. Against this, ich gives excellent health to the native, the white an's diet could only place tinned lard, tinned tter, and eggs whose yolks had depreciated ually through exposure to the sun. Bacon was erally tinned; smoked hams did not keep long the coastline.

The protein foods were fresh fish on the coast, ned in the bush, tough mutton and goat, and ngy fowl, except at the Kwitta end, where the unas reared on their grasslands cattle, sheep, ultry, ducks, and turkeys. But since meat led in the morning at 4 a.m. had to be eaten the ne night, it meant that butchers would not kill two or three white men alone. Where cattle e got through from the north they were not ed on the coastline except there were sufficient ple to underwrite the animal for one day's con- mption. The coast animals and fowls were rly devoid of fat, and none of the ordinary fish e oily. Frozen meat and frozen vegetables e unknown, fresh vegetables could not be ught from the islands owing to the long coasting ages then usually made even by the mail amers.

The native obtains his starch from bananas and ntains and fresh maize cobs, the young grain ng eaten whole. His root crops are yam, cas- a, and sweet potato; they were rarely eaten by cials, there being a prejudice against native hop." The only chance they had for anti- rbutic vitamin was in lime drinks, if taken. The ive soup had fufu balls like dumplings, made of ier grated yam, plantain, or young maize. ainst this native supply of vitaminized foods the ropean could only place white flour and polished .

The Old Treatment of Malaria.

It was natural to attempt to form a working hypothesis as to what this unknown disease might be, for successful treatment some theory is better than none. It was known that in addition to the first definite acute attack that the following conditions caused returns, that it was reawakened latent infection was not thought of. Over-exposure to sun and chill were the principal causes, the latter usually being due to sweat-soaked clothing drying *in situ*. Excessive fatigue, in the absence of either of the above two causes, and persistent high pressure brain work caused returns; the natives attributed most of their slighter attacks to constipation. Another cause held definite belief, acute and prolonged exposure to swamp and filth effluvia.

It was well recognized how alcohol and tobacco even in small quantities caused a relapse after an acute attack; if taken during the days of instability that followed. They were forbidden for usually the first day; tobacco was feared more than alcohol.

One of the medical men sent out soon after the Tropical School of Medicine started was really irate when the above causes of malarial attacks were stated; the tendency then was, and for long afterwards, to ignore the human factor, as we then called it, now known as "resistance." It was a case of the plasmodia, the whole disease due to plasmodia, and nothing but the plasmodia. In all these causes of recurrency the same factors are at work, the altered supply of leucocytes and opsonin and antigen products. The same kind of opposition existed from higher authority to the statements that the bad spells equally followed very wet seasons and those in which the rains nearly missed: in the latter the mosquitoes became concentrated in the white man's cisterns and in the natives' collecting storage pots.

The best hypothesis was that the fever followed on the accumulation of waste, of *materies morbi*, in the system: that ordinary elimination failed, and they had to be combusted off in the blood, while the skin was out of action. In the absence of known infection it was considered to be a disease of metabolism simply; the only difference now is that a specific reason for such is now known. It was also a matter of everyday and clinical observation that a man's electro-vital processes, as we would now say, became much more unstable and of greater irritability than at home, with greater tissue break-up. It was allowable from this to conclude that any fever process would be of greater intensity. These facts still remain, but a deeper cause is known. In my own case records were kept for three weeks on board ship, where circumstances could be controlled, of the amount of urea excreted per diem; not only was the amount at any time greater than at home, but on the days when no quinine had been taken the amount was about twice as much.

In 1893 the new antipyretics were coming into use: those available were antipyrin, antifebrin, and phenacetin. We would be called in to a man with the typical onset, rigors, fever, dry skin. In a

straightforward case, where the patient was not badly asthenic, and showed no cerebral symptoms, we thought nothing of a temperature under 105° F., especially if he had recently been taking quinine. If there had been a prolonged course of some weeks we expected a modified attack: it might be down to a single attack of a few hours. This was my own case, the exciting cause having been an accident which stunned for a few seconds in the fifth week after first landing. Or, if less protected, and with diminished resistance from unhygienic living, it might only be of three or four days, with several hours' exacerbation each day and complete intermittency in between. A bad case was one where there was a week or more of fever, never down below 102° F., with exacerbations up to 106° F. The degree of severity could be well compared to those of the ordinary febrile cold, slight bronchopneumonia, and lobar pneumonia of a severe type. Further experience led to the addition of another analogue—pneumonic—with a septic element in it; these we then called malignant malaria. Many of such are now known to have been yellow fever.

Our first object in treatment was to diminish waste of strength in every way, and to establish perspiration, as we then always found the temperature fell. If this could not be done we controlled by sponging the skin; in any case we gave complete rest to the patient; it was better to treat this stage in a native hut than to race the patient away in a hammock, which prevented reduction of the temperature.

Not four years ago, when seeing malaria again in West Africa, a new school man said, "Whatever do you want to produce perspiration for? I have been taught what you are aiming at is to kill the protozoa." That, it is submitted, is the result of laboratory study of disease, neglecting the patient factor, and his capacity for resistance. By so much as you did control and diminish the processes of waste, by so much was the patient's resistance the less entrenched upon, and by so much did he respond to the quinine given to kill the plasmodia, or reduce it to impotence for a time.

We gave antipyrin only to sthenic patients, and then only to those vomiting badly, as it would dissolve and antifebrin not, always guarding its depressing effects with a tablespoonful of spirit. Where the stomach promised to retain it we gave antifebrin by preference, reserving phenacetin for the asthenic cases. My personal method was, finding a patient over 104° F. to bring him down to under 102° F., when the waste of strength would be reasonable. If not over 102° F., to bring down to 100° F. One cardinal rule was never to reduce a patient to normal by drugs, a certain amount of pyrexia being regarded as curative, as combusting off waste. Having controlled the temperature, then came the time to put in quinine. Personally my view was that ten grains antifebrin had the effect of fifteen of phenacetin. If the temperature remained obstinately high a second dose would be given one hour after the first, but after that, if needed, at four-hour intervals.

In cases of blackwater, or of suspected malignancy with low temperature, a febrifuge mixture was given, the G.P.'s standby of pot. nit., pot. bic., sp. æther nit. Modern therapeutics can hardly improve upon this mixture, whose value was first proved by rule of thumb practice; it is diuretic and gently sudorific, it increases the alkalinity of the blood, and stimulates the ultimate circulation. Hippocrates himself would have approved of it.

Another method of control was through the skin itself, by direct treatment of it. A patient straight in from the bush, or one of unhygienic habits, needed a rub down with soap and flannel first to give his skin a chance of acting to drugs. This was all the more needful as the antipyretics indicated pushed up the temperature a little, while the skin remained dry; this further rise did not come down until there was a diuretic instead of a sudorific effect. If the patient had cerebral excitement the routine was to sponge him steadily with cooling lotion until the temperature fell. In the absence of ice, water as cool as possible was obtained and mixed with vinegar and limejuice. The head was kept cool with it, and the limbs sponged steadily from the extremities towards the trunk, the idea being to drive the blood into the trunk, as well as to return it cooler to the general circulation.

In hyperpyrexia the hot blanket bath was given, as also in asthenic cases of lower temperature, where drugs could not be pushed. The cold pack was only used for cases nearly *in extremis*, when all other attempts at control had failed.

Eggs, Ideal milk (there was no animal source), and Brand's essence were given. Quinine, then in the forms of the sulphate or hydrochlorate, was administered as soon as the temperature appeared to be controlled. Personally, my own practice was never to give more than 30 grains in a day. Fifteen grains at a dose was a maximum; in stomachs intolerant of it, five grains every few hours. Tabloids were reserved for prophylactic use if acute cases could not retain it in solution; it was tried in powder form in unsweetened condensed milk: cow's milk would be the ideal. On the second day of a controlled fever the prophylactic use was commenced; the period of exacerbation was expected generally between noon and three o'clock. Not believing in a bigger dose than fifteen to a man with coast cardiac atonicity, my custom was to divide it, fifteen at 7 a.m., ten at 11 a.m. This because experience seemed to indicate that the effect of the quinine nearly ceased in about eight hours, and that it produced appreciable effect in about four. Hence, if the fever exacerbation was expected at about noon (now we know it is due to the cumulation of the sporulation process), the first quinine was producing a marked effect by noon and finishing by about three. The eleven o'clock dose produced, then, its best effect as the first passed off, continuing up to early evening. The Germans in their experiments at Duala gave up the one big dose a week as a prophylactic in place of smaller repeated ones.

In convalescence these doses were tailed off by

gr. a day. First day, 15 and 10; second, 10 and 0; third, 10 and 5; fourth, 5 and 5; fifth, 5. further continuance depended upon the quality of he convalescence or the work being done. It enerally meant that quinine was now stopped until here was considered to be need for it; but in first ase fevers of newcomers my view was it should be ontinued until they had acquired the tropical constitution, one sign of which was a physiological ypertrophy of the spleen.

The conditions which were regarded as needing a enewal of the quinine for some days at least were he following. If any evening a man had a feeling f being specially well, preceded by yawning and a marting of the conjunctivæ, he was warned by old oasters to look out. We now know that this marked he pouring out of a minor amount of toxin, enough o act as a stimulant mentally. He was also warned f he was about to proceed on onerous work, or an ltered course of life, which would make demands pon his strength, or if he had minor ailments we ssociated with malaria, as rheumatic neuralgias, nyalgias, or colitis indigestion. It now works out, iven a latent infection prior to malaria, if malaria vas also acquired, that the resistance to the former me will break down if the latter becomes too active. It is submitted as a proposition that the ordinary man will speed up to furnish antigens and opsonins o meet three infections, but he cannot go further. In this consideration tobacco and alcohol are both regarded in excess as producing substances tending to their toleration. Since many of us acquire two out of these four, tubercular, rheumatic, streptococcic, or bacillus coli infections, it follows that a man who receives the malarial protozoa is weighted to the full without excess in alcohol or nicotine.

It was noticed on my first leave home, in midwinter, how quinine failed as a prophylactic; the observation has been repeatedly corroborated since. It was as if, being denied sudorific effects upon the skin, it was unable to function properly; arsenic seems to be the standby in the winter at home. But quinine is needed as a prophylactic when an attack is impending, or passing off.

In the days before the modern antipyretics quinine appears to have been used in large doses as a sudorific, twenty and thirty grains being nothing unusual. It is considered that the side effects produced by such doses neutralize any result possible before sporulation is effected. It was soon recognized that there was a form of malaria where the lowness of the temperature was in direct ratio to the gravity of the case, and where quinine was emphatically contra-indicated.

The fact that there are now estimated to be over a quarter of a million of men at home who have had malaria is the excuse for this reference to a vaso-motor form of the disease, as it appears to be to me. One point to be remembered is that a person may leave a malarious country with no definite history of malaria, but with the infection latent. If, as in the war, he was leading a hygienic life, especially if he took a course of quinine, the invading attack might be mistaken for a touch of the sun, a bad cold, or an attack of neuralgia. Worry, small bedrooms, and bad feeding, caused many an ex-soldier to blaze out with malaria his first winter at home. Blood examination will not show the protozoa, unless the specimen has been taken in the active stage; the tropical crescent infection is considered to lurk in the splenic and hepatic circulations, and only to be found in the peripheral blood during the sporulation process and pyrexia.

Quinine is useless as a prophylactic in the crescent infection except when the protozoa have returned for a time to greater vitality, some error in metabolism having provided them suddenly with eagerly utilized sustenance. For a few days after an attack quinine will do good, roughly as many days as there has been pyrexia, but after that a course of arsenic is indicated.

Thirty years ago, before the infection was understood, we were told that it needed at least seven years for the West Coast malaria to die out of the system, and that any acute attack during those years spun out the time further. This my own health has proved, as also the existence of this vaso-motor type, which still crops up on changes of the weather. The practical point about this condition is this. In private practice, if it is not recognized, a man's resistance capacity is constantly entrenched upon whenever it is present; his resistance to other infections is gravely diminished. The condition runs thus, and is due to toxin of a modified nature being created.

Marked cardiac irritability, sometimes with extrasystoles, not yielding either to rest or cardiac drugs, but yielding immediately to five grains of quinine, twice or thrice a day. Together with this is decided mental instability; some wives have commented upon how "ratty" the husband gets before an attack. In some cases they have regarded profuse perspiration, especially if of the aceto-acetone odour, as a warning sign. But the definite symptom, in addition to the above, is the sudden onset of cold, blanched hands and feet, perhaps passing into hot extremities after a time.

The Present-day Coast.

The writer saw it again for a few months in 1921-22, a very different place from 1893. There were even white men there who appeared to have in no way lost their European vigour; there were white girls, recently at school, going out to, or with their parents, as if it was India. One white child of five was out for six months on the coastline, leaving for home apparently no worse. This point ought to be mentioned about white women. Even in the bad old days the Sisters of the Sacred Heart, and the wives in the Basle and Bremen Missions, were able to stay out much longer than the wives of the officials or commercial men—the latter rarely stayed more than eight months. We could only conclude that the former did so because they led non-society lives; some of them stayed out for years.

The Gold Coast was known to me when there

were no railroads, and about twenty miles, perhaps, open to wheeled traffic. Transport is revolutionized now. Therefore the provision of cattle and vegetables from the upland zones, and from ice chambers from the shipping. Clubs exist in all large towns, and the medical and sanitary services have a proper opportunity to serve the community according to modern scientific needs.

There were many improvements making for health, but one stood out above all others. In the old days white men never thought of going more than a few yards in the sun between nine and four o'clock without the shelter of an umbrella; in 1921 an umbrella was hardly ever seen. Going over the whole ground of why this greater resistance to the sun, the answer appeared to lie in the present custom of taking five grains of quinine every day from landing until leaving, instead of as before, constantly only the first few months, and on occasion after as then judged needful.

Emetine Hydrochloride in the Treatment of Oriental Sore. Notes on a Further Series of Cases (H. C. Sinderson, M.B., Ch.B., M.R.C.P., *Transactions of the Royal Society of Tropical Medicine and Hygiene*, October 15, 1925).—In two series of cases the author has treated in all 147 sores, and in only one has the result been disappointing. The uniformly successful results obtained in the way described by the author do not only indicate the great value of emetine hydrochloride in the treatment of Oriental sore, but further, they give the drug strong claims to being considered a specific remedy for this disease.

A Disease in Wild Rats with Gross Pathology Resembling Plague (Public Health Reports, September 18, 1925—N. E. Watson).—There has been observed among the wild rats of Oakland, California, and the neighbouring cities, a disease the gross pathology of which resembles plague in rats. The specific factor in the disease is apparently one of the hæmorrhagic septicæmia group, which produces acute death in inoculated guinea-pigs, wild rats, and white rats, with resultant lesions resembling somewhat very acute plague in these animals. The practical importance of the disease is the difficulty it interposes in the routine diagnosis of plague in rats. The difficulty arises because of the similarity of plague lesions and those of this disease in the wild rat and because the presence of the disease in a plague-infected rat frequently results in the premature death of the inoculated test animal before the lesions of plague develop and before the plague organism has become widely disseminated through the tissues. The sanitary significance of these findings is as yet uncertain, since the pathogenicity of the hæmorrhagic septicæmia group, other than that of *Pasteurella pestis*, with regard to man is unknown.

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THE JOURNAL OF

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MARCH 1, 1926.

SYSTEMIC BLASTOMYCOSIS.

SYSTEMIC blastomycosis, the first case of which was reported by Busse and Buschke in 1894, is now recognized as a definite pathological and clinical entity.

The onset varies in different cases. Frequently

there can be elicited a history of a severe cold with cough, often with expectoration of blood-streaked sputum, though in a few instances localized painful swelling of an extremity or joint from secondary involvement appeared to be the first indication of infection. These cases seem to be due to pulmonary infection, and are often severe and rapidly fatal. More rarely the primary or principal lesion is an ulcer of the skin or a subcutaneous abscess without evidence of involvement of the lungs. In a few cases, moreover, the infection, while ultimately deep-seated and more or less extensive, does not seem to have become systemic, but to have spread progressively by direct extension or by metastases through the lymphatics without involving the deeper organs.

At the fastigium a typical case is not difficult to recognize, or at least to suspect. The outstanding features are essentially those of pyæmia. There is usually an irregular fever accompanied by chills and sweats. The skin and subcutaneous tissues are often extensively undermined by numerous large abscesses. Involvement of the osseous tissues is common and frequently widespread. Pulmonary implication is usually an early and characteristic feature, the persistent cough producing large amounts of purulent, often blood-stained, sputum. Pus or sputum mixed with 20 per cent. potassium hydroxide will usually reveal the blastomycetes, which appear as yeast-like, double-contoured budding organisms.

Once established, the course of the disease is usually subacute or chronic. So long as secondary infection is prevented, toxicity is seldom marked, even in severe and extensive infections. The patient usually emaciates more or less rapidly, becomes extremely weak, and ultimately dies of exhaustion or of some intercurrent affection.

Necropsies have amply demonstrated the systemic nature of the infection, and have also shown that certain organs or systems are more prone to extensive involvement than others. The most striking and characteristic feature of advanced systemic blastomycosis is the wide range of organs involved and the multiplicity of the infective foci not only in the same tissue, as for instance in the bones, but also in the different tissues and organs. This widespread dissemination is characteristic and the metastases are now believed to occur principally through the blood-stream. In view of these facts it is particularly interesting to note that the brain and meninges, especially the latter, are rarely implicated in the process.

Wilhelmj (*Amer. Journ. Med. Sci.*, May, 1925) emphasizes the infrequency of meningeal invasion, and points out a small group of cases to which he adds one of his own, which should be considered clinically as the primary meningeal form of systemic blastomycosis. In order to substantiate more forcibly the difference between ordinary systemic blastomycosis, with or without meningeal involvement, and the latter type, he analyses systemic blastomycosis with special reference to the onset and organs involved at autopsy, and he finds himself fully justified in recognizing a primary meningeal form of systemic blastomycosis which may occur without gross clinical evidence of systemic invasion.

F. E. T.

Annotations.

Observations on the Employment of Anaerobically-grown Bacillus dysenteriæ *Shiga as a Vaccine* (*Journal of the Royal Army Medical Corps*, Brevet Lt.-Col. H. Marrian Perry and Major C. J. Coppinger, October, 1925).

Suspensions of *B. dysenteriæ* Shiga cultures under anærobic conditions can be inoculated into man and animals in relatively large doses without the production of any excessive reaction, either local or general. The effect of such inoculation is to produce in the blood agglutinating and complement fixing antibodies to an extent which is comparable with that following inoculation of Shiga bacilli, cultivated under ordinary aerobic conditions. There is some evidence to show that an animal inoculated with the suspension of anaerobically-grown organisms is capable of withstanding doses of a suspension of aerobically-grown bacilli which were fatal to unprotected animals. A mixed vaccine, consisting of bacilli of the mannite-fermenting dysentery group, together with anaerobically-grown Shiga bacilli, can be administered to men without causing a greater reaction than that following typhoid-paratyphoid inoculation and produces demonstrable agglutinins for both types of organism.

Some Observations on Malignant Tertian Malaria in Trinidad, B.W.I. (Eric De Verteuil, M.B., B.S., *Transactions of the Royal Society of Tropical Medicine and Hygiene*, October 15, 1925).—The conclusions of this interesting article are that prompt and early injection of quinine, in cases of malignant tertian malaria, may be most satisfactory, its delay may lead to the bitterest regret. In adults an intramuscular injection of 25 to 40 gr. of quinine bi-hydrochloride is usually given, according to the severity of the case, repeated within six to nine hours; after which oral treatment can usually be started in those surviving. There should be no hesitation in continuing the injections in obstinate cases. In *children*, those up to one year can usually be given an intramuscular injection of 5 gr.; to those from one to three years one of 7½ gr.; from three to five years of 10 gr., and from five to ten years of 15 gr. In each case the injection is repeated in six to nine hours. More than two injections may often be necessary. These must be intramuscular, not subcutaneous. I have particularly noticed how remarkably well children stand quinine, and have never seen any ill effects from its use, except for necrosis of the tissues, which sometimes occurs after injections. I have no experience of the intravenous method. There can be no doubt that the malaria of the West Indies is

similar in origin and in development to the malaria of Central America. The results of adrenalin in the treatment of vomiting are remarkable. In bad cases an injection of five to eight minims of the hydrochloride (1 in 1,000) will often put an immediate end to all vomiting and nausea; with moderate vomiting the oral administration of eight minims in 1½ oz. of water will prove just as efficacious. It has also been used as a routine in the usual quinine mixture for all cases of malaria (4 minims to the dose and giving three doses a day for four days), and there is reason to believe that it helps materially in the quicker recovery from all the usual distressing symptoms—the patient being able to take the mixture much more readily and to eat more heartily than had previously been the case.

The Pathology of Diabetes with Special Reference to Pancreatic Regeneration (Shields Warren, M.D., and Howard F. Root, M.D., Reprint from *American Journal of Pathology*, July, 1925).—A new interpretation is offered of the pathology of the pancreas in diabetes mellitus. The long continued action of an injurious agent (or possibly excessive functional activity) causes a gradual destruction of island, and at times of acinar, cells. New cells are formed to take the place of those destroyed, only to be exposed to the injurious influence with consequent pathological change. Their injury is followed by the production of still more new cells. Eventually the destructive process wears down the regenerative powers of the pancreas, thus explaining the unfavourable course of the disease. In pneumonia and other infectious diseases the pancreas readily regenerates after acute injury. The disturbed carbohydrate metabolism giving rise to abnormal fat or protein metabolites may be the cause of the high incidence of vascular disease in diabetic patients.

Primary Lung Tumours in Mice following the Cutaneous Application of Coal Tar (James B. Murphy, M.D., and Ernest Sturm, *Journal of Experimental Medicine*, November 1, 1925).—The external application of tar to a number of separated areas on the surface of mice, in such fashion that no single area is irritated sufficiently long to cause lesions of the skin, has resulted in a very high incidence of lung tumours. This incidence ranged from 60 per cent. in one experiment to 78·3 per cent. in another. Control mice from the same stock, but from three to six months older, and for that reason more liable to spontaneous lung tumours, failed to show a single instance of such growths. The tumours in the tar-painted animals occur as small white nodules, either single or multiple. They are typical epithelial neoplasms, identical histologically with those described by previous authors as occurring spontaneously in mice. Some possible factors in the causation of the tumours are briefly discussed.

Abstract.

SOME NOTES ON LATRINES AND HOOKWORM INCIDENCE ON AN ESTATE, AS DIAGNOSED BY THE CLAYTON-LANE CENTRIFUGE.

By Ronald Senior-White, F.E.S.,
(Malariologist, the Kepitigalla Rubber Estates, Ltd., Matale.)

The estate to which the following notes apply is in most respects typical of company-owned estates in the island of Ceylon. It seems probable, therefore, that the publication of figures showing the incidence of ankylostomiasis eight years after the Rockefeller Commission commenced work in the island will be of interest to those working on the disease.

Prior to the commencement of the Commission's campaign the estate, in common with practically every other such, provided no latrine accommodation for its labour force, who resorted for purposes of nature to the area around their lines, as was only too apparent to the nose when in the vicinity of the latter.

With commencement of work by the Rockefeller Commission, the provision of latrines was enforced by law. On the estate in question these were constructed over pits dug in laterite soil to the depth of sixteen feet, their sides being practically vertical and, after the first few feet—varying with top-soil depth in individual spots—of a hardness nearly comparable with a chalk pit in England. The buildings themselves were of tarred weather-boarding with corrugated iron roof, the squatting places being also of board, which was re-tarred at suitably frequent intervals. Each pit served four to six actual squatting places, the two sexes being accommodated on separate sides of a central wall. To each side a cement-floored ablution cubicle, draining into the pit, was provided and cemented inverts drains caught the roof-water and led it away from the pit. The original cost of such a latrine of four places, including digging the pit, averaged about Rs.250.

On this estate the latrines are all situated on a steeply-sloping hillside, and the pits nowhere struck subsoil water. They have remained absolutely dry throughout their existence. If such is struck, and the pit contains standing water, *Culex fatigans* will breed freely therein. To this is due the intolerable nuisance found in some of the wetter and more elevated districts of Ceylon, where mosquito nets are now absolutely essential, whereas, before the latrine ordinance, there was no need for such.

In practice it has been found that two squatting places for each sex for a set of ten line rooms (accommodating from twenty to twenty-five persons of over infantile age) is sufficient. One latrine of this size serving twice this number of rooms

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[1] Abstract from the *Indian Medical Gazette*, December, 1925.

caused much fæcal pollution around the set of lines concerned until it was duplicated. Lids to the holes in the squatting places, self-closing by gravity, were originally provided. These proved unsatisfactory. The coolie usually fouls the squatting place around the hole, and when the lid falls back on the mess it is in no state to come into contact with the back of the next user.

Examination of the surface of semi-liquid mass of fæces in the pits by means of a torch has at times revealed a crawling mass of larvæ, mainly those of *Chrysomyia megacephala* Fb., adults of which have been noticed resting on vegetation around the latrines, but no fly nuisance has ever resulted. The explanation would seem to be that the larvæ must find dry loose earth for pupation, and such is not available above the mass on the hard, nearly vertical sides of the pit. The prepupal larvæ therefore, I think, perish. Oviposition must have been by eggs dropped into darkness for several feet. I do not think that any fly would descend into the pit itself, and on various torch examinations I have never noticed adults in the pits.

Naturally the pits must slowly fill up, however efficient bacterial action may be, but out of seven sets erected in 1917-18 it has only been necessary to close two for this reason up to the middle of 1925. One of these was a 6-place set, now replaced by two separate sets of smaller capacity, and the other served twenty rooms as mentioned above. It has also been duplicated. At the moment of writing one more set now requires replacement, the first set of four places serving only ten line rooms to fill up.

It is possible that the periodic rises of level, attributed to overuse, are not due to this, but to inhibition of bacterial action by the use of disinfectant. A little of the cresol compounds used in line sanitation must at times find its way into the pits, but I have never been able to correlate a bacterial upset with the emptying of a quantity of such solution into the affected pit, or the addition by sweepers of unauthorized substances, such as line rubbish containing fermentable vegetable matter, which is said to be a cause of unsatisfactory bacterial action, and I think the original explanation is correct. There is probably a definite ratio between the surface area of a pit and the quantity of fæces that can be successfully dealt with regularly, but I have never attempted to work this out.

Fæcal pollution of soil on this estate has been very carefully checked for the last seven years, until now it is ordinarily non-existent. Nevertheless, so ingrained in the Tamil coolie are his filthy habits that the least relaxation of vigilance always results in an outbreak of promiscuous defæcation. Punishment, or the fear of it, alone keeps the latrines in proper use. Such a result can only be achieved on an estate where the labour is under perfect control and is not otherwise discontented. On many estates the latrines exist more to comply with the law than for use.

Turning now to ankylostomiasis itself, the estate in question, in common with most of those in Ceylon, showed an infection rate of 98 per cent. to 99 per cent. by the simple smear method when originally surveyed. Being situate in the district in which the Rockefeller Campaign started operations, the original treatments were given without latrines being installed, and therefore for at least a year after reinfection must have occurred copiously. The rainfall on the estate is about 80 inches per annum, most of it in the North-East Monsoon, at which time of year the original treatments were carried on. No routine treatments were made for six years afterwards. Bad cases coming from India or other estates were treated soon after arrival by the dispenser, without microscopic diagnosis. In other words, " bad cases " would mean those showing a noticeable degree of anæmia and œdema—that is, very bad cases indeed.

The writer brought back with him from leave last year the then newly-demonstrated Clayton-Lane centrifuge for ankylostomiasis diagnosis, the first, he believes, to reach the island, and with it a routine examination of every coolie inhabitant of the estate was made. Owing to pressure of other work it was not found possible to carry out the complete Clayton-Lane technique for quantitative results. All that could be done was to take a lump of fæces approximately equal in bulk to 1 c.c. and emulsify it direct in saturated saline, the tube being then filled up till the meniscus stood just above its mouth, the cover-slip was applied and the whole centrifuged.

My laboratory boy and a sweeper under the supervision of the estate dispenser formed a gang just sufficient to keep myself at the microscope continuously occupied. The routine of operation was as follows:—

The sweeper opened the sample tins and removed and emulsified the material in about three-quarters of a tube of saline, standing each tube as completed in a test-tube rack. The dispenser meanwhile moved the opened tin and its labelled lid opposite the corresponding tube in the rack, and filled the latter up to the top. Then in the centrifuge bucket he added by a pipette the final amount of saline necessary to touch the cover-slip, and applied the same. The laboratory boy worked the centrifuge, carried slides to and from the microscope, and washed cover-slips. The sweeper washed the centrifuge tubes. Generally four slides, numbered consecutively to agree with holes in the test-tube rack, were used. The microscopist quoting the number of the slide under examination, the dispenser identified it with the patient from the label of the tin, and the result was entered. With this staff doing only quantitative diagnoses, it was found possible to do nearly sixty samples per hour after everyone had become used to their duties. Much longer has to be spent on a negative than on a positive slide.

The original treatment by the Rockefeller Commission was made with chenopodium oil—in the series now under discussion this was used for children and adults showing *Ascaris* infection, but the chief drug used was carbon tetrachloride. Coolies have no objections to the latter. In fact,

some negative patients asked for it when those still positive were under retreatment. It apparently has a somewhat alcoholic effect much appreciated by the coolie. No accidents with it have occurred here. The dosages were indicated by officers of the campaign as usual.

It will be observed that the numbers examined after the first treatment are less than those of the original examination. This is due to the omission from the former of negatives and those exempted from treatment for the usual conditions. In the fourth examination, made a year later, every inhabitant of the estate was again tested.

TABLE I.

	A. Apr. 3, 1924	B. Aug. 5, 1924	C. Sept. 18, 1924	D. June 11, 1925
No. examined	231	187	192	222
Ankylostoma positive ...	177	130	89	115
Ankylostoma negative...	54	57	103	107
Ascaris	8	30	41	54
Trichuris	3	22	24	42
Per cent. with *Ankylostoma*	77	69	46	52
Per cent. with *Ascaris*	3	16	21	24
Per cent. with *Trichuris*	1	12	13	19

A. No general treatment since 1917.
B. General treatment on July 3, 1924.
C. Retreatment of cases still positive on August 22, 1924, and September 4, 1924.
D. No general treatment during intervening period.

Analysis of Column D.

	Examined	Positive	Negative	Per cent. positive	
New coolies ...	29	21	8	72	All heavy
Old coolies ...	193	94	99	49[1]	40 per cent. of positives with 1-2 eggs only.
	222	115	107	52	

[1] Increase over column C due to inclusion of exempted coolies.

One very extraordinary point is brought about by the figures given above, viz., that apparently the more treatment that is done, the higher becomes the incidence of *Ascaris* and *Trichuris*. I am quite at a loss to account for this. The rise in the former after the first treatment, from 3 per cent. to 16 per cent., cannot represent fresh infection occurring in the intervening four months. Can it be that treatment irritates the worms into oviposition? Carbon tetrachloride is said to have no effect on *Ascaris*, and it is not known whether the ascaricidal fraction of the chenopodium oil was high. In any case, statistically, the position as regards *Ascaris* is worse at the end than at the commencement of treatment. It was obvious also, when doing the actual examinations, that ascariasis is largely a family infection. This must mean food contamination, and it would therefore appear that special attention to mothers of families who show ascariasis should be undertaken.

As in all labour forces there is a constant in and out movement of coolies, though it is smaller in the case of the estate under discussion than in many known to the writer. The figures of the last examination have therefore been subdivided to show new and old coolies separately, the latter being those who were present during the treatment of 1924. New coolies, in this instance, have none of them come direct from India, but all from neighbouring estates, and the incidence among these coolies, in spite of the fact that obviously infected cases were treated on arrival, is nearly double that of the old coolies of the estate, while in every case the amount of individual infection appeared higher. It is to be feared, therefore, that on most estates the ankylostomiasis incidence is still in the vicinity of 70 per cent., a fact which reveals how much has yet to be done before this disease is got under control.

TABLE II.

	Samoa. Infected Per cent.	Samoa. Reduction Per cent.	Ceylon. Infected Per cent.	Ceylon. Reduction Per cent.
Before treatment ...	97	—	77	—
After first treatment	59	38	69	8
After second treatment	37	22	46	23

Comparing the foregoing table with the figures recently published from Samoa, using the same technique (Hopkins, 1925) we get:—

Even allowing that the original reduction in the Ceylon series had been from about 98 per cent., and that, if the first treatment of 1924 had been on virgin ground as in Samoa, the reduction might well have been from that figure down to 69 per cent., we still find that there is less reduction for first treatment in Ceylon than in Samoa. The reductions for the second treatment are practically identical in the two islands, and at the end of it both sets of patients were left with a large amount of residual infection. Probably little of this was economically important to the patients themselves—and if everywhere proper usage of latrines was in force would have comparatively little importance, but there is no word of the use of latrines in the Samoa paper, and we know that they are very ineffectively used in Ceylon, hence these half-cured cases may not only get more heavily infected themselves, but are still liable to act as disseminators of the disease. The first is likely to be of more occurrence with many of those treated here, for at the final examination 38 of the 94 positive among the old coolies, or 40 per cent., showed only one or two eggs in the film made from approximately 1 c.c. of stool. These would count as negative "cured" under any technique less delicate than that of Clayton-Lane. This is simple and sure, and even for routine campaign diagnosis an immense improvement on any of the pre-existing ones. I would like, however, to confirm Hopkins' remarks about the apparatus. The plating and paint is rapidly and badly attacked by the salt solution, though in my case the aluminium arms have not been affected. The handle also should be of stronger construction for unskilled use. With advantage also the arms might be permanently numbered so as to render tube-tin-slide identification simpler, but these points are all minor blemishes such as invariably show themselves in any new pattern of apparatus, and will doubtless be rectified in later manufacture.

Reprint.

THE "PURU" OF MALAYA: ITS TREATMENT AND ERADICATION.[1]

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INTRODUCTION.

OF the many diseases that are prevalent in Malaya, none is of more interest and importance to the native population than the disease called "Puru." Although it is not in itself a fatal disease, it has wrought havoc among the Malay people. By impoverishing general health it paves the way for other diseases and thus indirectly raises the sickness and mortality rates.

Its effects on the community are far-reaching. It is a great hindrance to the progress of the race and the material development of the country. Many of the unfortunate individuals stricken with the disease are disabled from work, or at least from performing their work efficiently. Others, as a result of deformity, prove a burden on the community.

THE PEOPLE AND THEIR HABITS.

The Malay lives a simple life. His wants are few, and Nature is so bountiful that these are readily supplied with the expenditure of little energy. His chief occupation is paddy cultivation and fishing. He bathes in, and drinks from, the many streams and rivers that abound all over the country. Fruits are abundant and varied, but the "durian" is the favourite. His dress is simple, consisting of a piece of cloth which he wears round the waist and which reaches to the knees, and of another with which he covers the upper part of the body. His arms and legs are thus left bare, and he goes about with bare feet. He lives in thatched huts with bamboo walls and flooring raised a few feet above the ground. The ground underneath is invariably damp, partly due to the heavy rains, and partly to the refuse water from the kitchen which finds its way below through the floor.

GEOGRAPHICAL DISTRIBUTION.

Puru has existed in Malaya for very many years, affecting chiefly the aborigines and others of the indigenous population; the former are the Sakais, the latter the Malays and Javanese. It is also prevalent in the various East Indian and Pacific Islands and in Ceylon. In Ceylon it is called the "Parangi," from the belief that it was introduced by the Portuguese (*Ferangi*), in Africa "Yaws," or "*frambœsia*," from its resemblance to the raspberry, in Fiji "Coko," and "Buba" in the Pacific Islands.

DEFINITION.

Puru may be defined as a specific contagious disease, with an uncertain period of incubation, and characterized by a series of crops of characteristic skin eruptions. It runs a definite course, attacking all persons irrespective of age or sex.

CAUSE.

In all countries where yaws is prevalent the consumption of various articles of food is said to be the cause of the disease. In Malaya, certain kinds of salt fish and a particular rice are blamed. Malays also believe that the eating of durian fruit aggravates the disease, and that fresh crops of the eruptions occur when this fruit is in season. In Ceylon the eating of "kurakkan" (ragi) and some variety of fish is said to bring on the disease. A cold and humid atmosphere is thought to aggravate symptoms. Be this as it may, medical science has proved that the cause of the disease is the presence of a microbe, the *Treponema pertenue*, a minute organism measuring from 0·000204 to 0·000278 in. in length.

MODE OF SPREAD.

The microbe enters the body through trivial wounds or sores on exposed parts of the body, such as result from scratches, leech-bites, contact with "machang" or "durian" blossoms, from itch mites, &c. The infected sore is slow to heal and becomes indolent, developing ultimately into the typical yaw. Personal contact, or contact with infected clothing or household utensils and other implements of everyday use, serves to spread the disease.

The frequency of the disease in "kampongs," and its rarity in towns, seem to show that it is one of the diseases associated with filth and general insanitary conditions. The house-fly possibly plays an active part in dissemination. Open ulcers are often found covered with flies, and it is reasonable to suppose that the germs are spread from the diseased to healthy persons in this way.

In a series of hundreds of cases that came under the writer's observation the avenues of invasion were parts exposed to injury, such as feet, legs, back of the elbows, arms, face and front of the knees.

The relative frequency of infection in the upper and lower limbs was 1 : 2. In children the frequency of the primary sore about the mouth and face points to foods or food utensils as possible vehicles of infection, but flies hovering about the face of a child may be the vectors. In Ceylon it was a practice to feed a child with food which had been previously contaminated by an infected individual with a view to causing a mild infection and thereby induce immunity.

INCUBATION.

Once in the body the germs multiply, but symptoms are not produced until they have attained enormous numbers. The time taken by them to multiply to such an extent as to cause symptoms is called the "incubation period." This varies from a few weeks to months.

INCIDENCE AND RACE.

It is believed that among the Malays of the Malay States, 60 persons out of 100 either have or have had puru. Chinese and Indians also contract the disease, especially in the interior of the country, where it is most prevalent.

[1] Published for The Committee for Public Health Education of the Federated Malay States, by John Bale, Sons & Danielsson, Ltd., 83-91, Great Titchfield Street, Oxford Street, London, W.1.

Age.

All ages are affected, but the liability to infection is greater in infancy and childhood. Of about 1,500 cases observed, the youngest was three months old and the oldest 90 years. The great majority contract the disease in childhood.

Sex.

Both sexes are equally liable to infection, but the ratio in the cases observed was three males to one female. This is due purely to the greater chances of injury and exposure to infection in the male child.

Transmission.

The disease is not inherited. Not infrequently a nursing mother gets infected by suckling a child with sores about its mouth, and who contracted the disease from another child while playing or taking food with it. It is not as a rule transmitted by sexual intercourse, as is the case with syphilis, but it is conceivable that the disease may be so contracted in the presence of lesions.

Signs and Symptoms.

The signs and symptoms of the disease are usually divisible into three stages, viz., the first stage or stage of onset; the second stage, the stage of evolution; and the third stage, the stage of decline. Before the onset of the disease the individual may have nothing more than a feeling of lassitude, slight fever and malaise.

First Stage.—The initial lesion or sore that develops at the site of inoculation is usually single and is called by the Malays *ibu puru* (mother of puru). It appears to arise from the deep tissues of the skin and push its way through to form what is termed a *granuloma*. This varies in size and shape. The distinctive characteristic of puru may be described as an eruption of one or more small papules, which increase in size and secrete a viscid yellowish discharge which dries and forms a crust or scab. On removing the scab a raw surface is exposed, which bleeds readily and looks not unlike a "rambutan" in colour and appearance. This sore may heal up, leaving hardly any scar, or it may, on the other hand, take a chronic course and leave a permanent scar. The initial sore may last as long as six to twenty-four months, with or without evidence of the second stage.

Second Stage.—This consists of eruptions which appear in successive crops for several years. The typical eruptions consist of *granulomata*, similar to the initial sore, varying in size from a pin's head to an areca-nut and are termed by the Malays "anak puru," i.e., "the child of the yaws." These eruptions, which may be accompanied by an irregular fever of short duration, appear some weeks or months after the parent sore. They may co-exist with, or appear after, the parent sore has healed up. They may be discrete, or confluent, occur in any part of the body, or affect its entire surface. In infants and children the confluent type is most common. The tendency towards the discrete type increases as age advances. The backs and fronts of the arms and legs are equally affected. The eruptions may be of various sizes and shapes, they may be round, oval, or ring-shaped or irregular, and are given corresponding names by the Malays, viz., "puru sipit," "puru mata-kerbau," "puru tapak-anging," "puru parang," "puru bubol," "puru sipit mulut," "puru durian," "puru bunga," "kedal," &c.

Wart-like eruptions on the palms of the hands and soles of the feet are said to recur every year with regularity during the "durian" season. A most common type of lesion is the pitted sole. In it the skin of the sole appears as if it had been perforated by a pin. Another common foot lesion is the thickened sole, in which the skin shows areas of thickening; when these protrude above the surface and crack, the enormously thickened skin appears as if split through by some protruding mass. In one case the whole skin on the back was covered with minute eruptions resembling the rind of the jak fruit. The eruptions run their course and heal up, or as a result of infection by other organisms, ulceration may set in involving large areas of skin. The bones may become affected and thickening result. The ends of the bones of the arms and legs may become involved and deformity result.

In one case, that of a girl, the bones of the arms, legs, fingers and toes were enormously thickened and necrosed. In some cases the joints are swollen and tender, in others pain only is complained of. In rare cases the bones of the feet are affected so as to produce a condition resembling "madura foot."

The Third Stage.—This may set in during or after the second stage. It generally consists of an affection of the skin in the palms and soles and is called by the Malays "kedal." In slighter cases the skin presents a condition of exfoliative dermatitis, with superficial cracks and fissures. In severe cases the skin is thickened, cracked and fissured, and in some there is ulceration, making it impossible for the patient to walk or grasp anything. This stage may persist for years with exacerbations. Together with this, or after the exfoliative condition passes, the skin may lose its pigment and presents a condition almost resembling *leucoderma*. It regains its normal appearance after treatment with *novarsenobillon*. In neglected cases and enfeebled constitutions the eruptions of the second stage are followed by extensive ulcerations leading to the loss of fingers and toes, and to permanent contractions and deformities.

Diagnosis.

This is generally easy in endemic areas. The typical *granulomata* of the first and second stages could hardly be mistaken for any other disease, but in cases which deviate from the typical, one must be guided by the history, age, race, &c. With careful observation and diligent inquiry, the seat of the primary sore can be ascertained. In cases showing the manifestations of the third stage there is likely to be difficulty, but it can be overcome by inquiry and search for evidence of past lesions, scars, deformities, &c.

Prognosis.

This is very favourable, as the disease can be arrested in all its stages. If treatment is given as soon as the disease manifests itself, there is great likelihood of prompt cure and prevention of the further ill-effects that result from this disease.

TREATMENT.

Although puru has existed for centuries its treatment was unsatisfactory until a few years ago, when Professor Ehrlich synthetized a compound of arsenic known as *salvarsan*, and a later modification, *neosalvarsan*. In *neosalvarsan* and *novarsenobillon* (allied preparations of arsenic) we have remedies *par excellence* for puru. Since Ehrlich's discovery hundreds and thousands of people who were dragging on a miserable existence have been cured. In the Malay States systematic treatment with *novarsenobillon* on a large scale was begun in Kuala Kangsar by the writer about five years ago, where hundreds of people from various parts of Perak were cured or benefited. The simplicity of the method of treatment, and above all its efficacy, has enhanced the value of scientific medicine in the eyes of the Malays and created a keen desire for the cure of yaws. Government has now placed this cure within the reach of every person throughout the States by sending out medical officers to visit the people in their "kampongs," where centres are arranged and injections are given free. The affected individual has only to visit either the local centre or the nearest hospital, where he will be promptly treated. He should attend until he is declared cured by the doctor. Besides medical treatment, due regard must be paid to the diet and cleanliness of the patient and his surroundings. The administration of such a potent drug as novarsenobillon should not be undertaken lightly. Its action varies with each individual. Some patients feel sick almost before leaving the table, whereas others do not experience the slightest discomfort. The immediate effects may be a feeling of nausea, vomiting, occasionally fever (99-102° F.), congestion of the face, giddiness and, rarely, collapse with profuse perspiration. These symptoms may be transient and pass off quickly.

Toxic symptoms seldom develop earlier than five to seven days.

Care must be taken in the case of women not to exceed 0·3 grm. of the drug at one time, and in the case of men not to exceed 0·45 grm. It should not be employed in patients who had been under prolonged treatment with *arsenic* or *antimony* by the mouth. The writer has seen at least one such case resulting in peripheral neuritis followed by gangrene of the lower limbs.

PREVENTION.

This is a matter of hygiene and rural sanitation. To avoid contracting the disease attention must be paid to all wounds and sores, however trivial they may be, and to have them dressed so that no flies might get on to them. All rubbish which helps to breed flies must be burnt and the dwelling-houses and their surroundings kept clean. Personal and domestic cleanliness must be the aim of every individual. Every person suffering from puru, as well as his clothing, bedding, &c., must be kept apart and away from flies.

ERADICATION.

Eradication of puru from a country where it has existed for centuries, and parts of which are yet to be opened up, is no small task. But any labour and money spent on eradicating this disease would be justified by results. If the following measures are taken, with the intelligent co-operation of people who realize the baneful effects of the disease, we may with confidence hope to see the eradication of puru from the Malay States.

(1) Every individual who suffers or has suffered from the disease must be examined, and if necessary undergo the treatment. Every individual so cured is one less centre of infection.

(2) His family, relations and servants should likewise be examined.

(3) He must tell those who are not familiar with the disease about its symptoms and the ease with which it can be cured.

(4) We must instruct his household to prevent the breeding of flies by maintaining domestic and personal cleanliness.

(5) Every individual who has puru must be looked upon as a menace to the health and advancement of the community, and therefore isolated from the healthy until free from risk of spreading infection.

(6) People must be warned that new arrivals in the "kampong" showing active signs of disease must be kept isolated, otherwise the whole "kampong" may become infected.

(7) Healthy individuals should never eat from the plate from which a diseased individual may have eaten, or share food from his hands. All social dealings with infected people must be stopped.

(8) A census of all persons suffering from yaws should be taken, and all such persons required to attend for treatment.

(9) Lessons on elementary and personal hygiene, with special reference to the household fly as a disease carrier, should be included in the school curriculum, and lectures given to the adults when opportunity offers.

CONCLUSION.

Although puru has existed in almost all the tropical and subtropical regions of the world for several centuries, systematic attempts at eradication commenced only a few years ago. Many observers have recognized the disease as an entity, while others confound it with syphilis, lupus, gangosa, leprosy and skin diseases. This is perhaps due to insufficient acquaintance with the varied symptomatology of the disease. This short account of puru is meant for those who may have to deal with the disease in Malaya, and also for the information of the general public, so that by intelligent understanding and co-operation, prevention and cure may eradicate this disease from the country.

Current Literature.

THE AMERICAN JOURNAL OF TROPICAL MEDICINE. Vol. V, No. 6, November, 1925.

General Report on the Yellow Fever Campaign in Colombia, May 1923, to December 31, 1924 (Henry Hanson).—Until the outbreak of yellow fever at Bucaramanga in March, 1923, it was believed that the disease did not exist in Colombia. The campaign was carried out here and at several

other places of importance and principal seaports. The total number of recorded house visits of the general campaign is 910,845. In the course of these inspections houses were found breeding *Ædes ægypti* mosquitoes in 69,690 instances. The distribution of 364,926 fishes as larvæ consumers is recorded. The use of fish in Colombia was not followed by the striking beneficial results expected, on account of the fishes being delicate, also because the people would not co-operate in the care of the fishes distributed. In places where proper attention was given to the fish no larvæ were found. While it is believed that there is now no yellow fever in Colombia, the disease would probably spread extensively were it reintroduced into the country on account of the generally high mosquito index, and for this reason serious attention should be given to the control of *A. ægypti*.

Prevalence of the Yellow Fever Mosquito, Ædes ægypti (Linn.), in Colombia (L. H. Dunn and H. Hanson).—During the recent campaign against yellow fever in Colombia mosquito control measures were carried on at the more important centres and main key points of travel. Many other towns and villages in various parts of the country were also visited and inspected. This gave quite a complete survey of the distribution and prevalence of *A. ægypti* throughout the Republic. A total of fifty-six places were investigated for mosquito breeding, at eighteen of which control measures were established, preliminary inspections only being carried on at the other thirty-eight.

Mosquito breeding was found at forty-six of the fifty-six places inspected. The highest house index was 96 per cent. at Banco. The lowest was 6 per cent. at Buenaventura. However, at this latter place control measures were being continued from a previous campaign. The lowest index found where no control measures had been carried on preceding the inspection reported was 13 per cent. at Florida. The house indices of forty-five of these places with breeding may be roughly grouped as follows: eight were less than 25 per cent., nine between 25 and 50 per cent., eighteen between 50 and 75 per cent., and ten were more than 75 per cent. Four places, Banco, Villamizar, Cucuta and Quibdo, gave indices of more than 90 per cent. No index was obtained at Aracataca. An accompanying map of Colombia illustrates the locations of the various places where these investigations were carried on.

Geographical Distribution of the Serologic Groups of Brucella melitensis (Alice C. Evans).—The results of this study show that the various serological groups of *B. melitensis* are not limited to particular species of host animals. The prevailing idea that the so-called "*Bacillus abortus*" is a bovine infection and that the so-called "*Micrococcus melitensis*" in a human and goat infection should be revised. The *abortus* variety is characteristically a bovine infection, for twenty of the twenty-three bovine strains fell into this group. The *abortus* variety is also the variety which infects hogs most frequently in America, for eight of the nine porcine strains fell into this group. It is now an uncommon agent of human infection, for five of the twenty-three human strains fell into the *abortus* group. The table shows that the *melitensis* A strains in this collection came from human, caprine, bovine and equine sources. Since the two varieties of the organism cause the clinically typical Malta fever in man, and both cause the same kind of disease in animals, there are practical reasons as well as scientific for considering the entire group as a single species.

Suspected Yaws in Costa Rica (Solon Nunez).—In the zone of Coto and Golfo Dulce (boundary zone between Costa Rica and Panama) there exists a dermatosis which is contagious, with tendency towards an epidemic character. The clinical and serological characters and the influence of the arsenical treatment leads one to believe that it is a spirochætosis. The form of the papules, their colour and their mode of evolution make one think of yaws. Failure to find the spirochæte was probably due to the advanced state of the disease. The cases of yaws described, if correctly diagnosed, appear to be the first to be reported from Costa Rica.

Experimental Immunity in Syphilis and Yaws (Henry J. Nichols).—The author reviews the work of recent investigators and gives an account of his own experiments which clearly suggest that yaws protects against syphilis. The recent demonstration of a true immunity in syphilis throws new light on this question. Experimentally, a partial immunity against syphilis can be demonstrated in rabbits which have been infected a long time with yaws and cured by arsphenamin. The subject of strains must be taken into account, both in yaws and syphilis.

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17th *February*, 1926.

Original Communications.

FINAL REPORT ON THE TREATMENT OF TRYPANOSOMIASIS IN UGANDA.

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AND

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THE treatment of trypanosomiasis by means of rathecal salvarsanized serum having recently en far less successful than was previously ported, we felt it incumbent upon us to give blicity to that fact, and did so by means of a ter in the *British Medical Journal* in June, 1924. We would wish, however, to place on record the ults of our experiments up to date, since even e records of failures may not be without their lue, and also as, owing to the exigencies of the rvice to which we belong, we are no longer in a sition to continue our investigations.

The methods of treatment which we consider as ving failed were carried out in the Madi country. the Nile district, during April and May, 1922, ong natives far more primitive and uncivilized an those round Mbale. As indicated in our mmunication to the *British Medical Journal* of bruary 10, 1923, they were planned to investigate e suggestion, offered by Dr. Shaw Mackenzie, at the results obtained by serum treatment might e due to fat-splitting by the autogenous serum, d also to attempt to perfect a single treatment ith simple technique which would enable the tient to resume his normal life after a few days, d so avoid the prolonged courses of injections ich necessitate the removal of the patient from village and friends and his confinement in some eping sickness camp or hospital.

Before commencing treatment of any kind we deavoured to make some classification of our ses according to the different stages which the sease had reached, to facilitate a correct evaluan of any results which might be obtained.

The necessity for some such system is apparent. r instance, Broden and Rodhain, in the Congo. ite that good results may be obtained from the travenous injection of salvarsan, but they insist at it is only of benefit in those cases where micropical examination of the cerebro-spinal fluid ows that invasion of the spinal canal has not curred.

The invasion of the central nervous system may presumed in the later stages from the clinical ns, and in this connection Manson (7th edition, ge 125) definitely states, " Later there may occur rillary twitchings of the muscles, especially of tongue, and tremor of the hands, more rarely of legs, indicating a definite implication of the otor centres."

In the early stages of the disease the question is ore difficult, since, while theoretically the absence parasites or increased cell contents contradicates an infection of the central nervous system, this may not be a matter of actual fact, since a few trypanosomes in the cerebro-spinal fluid may escape detection.

The classification we adopted was as follows:—

Class A.—The onset of infection. Characterized by the presence of trypanosomes in the blood, but without glandular enlargement. The patient has constantly recurring attacks of pyrexia, associated with great malaise, pains in the head and back. Skin rashes may be present, but there are no nervous symptoms.

Class B1 (subacute).—The spread of infection from the blood to the lymphatic system.

The cervical chain of glands is enlarged, individual glands varying in size from a pea to a cherry; the larger ones are usually " typical " on palpation, i.e., they feel like a ripe plum. Trypanosomes are present in the gland juice. There are no nervous symptoms, knee-jerks are normal, and there are no tremors of the tongue or fingers.

The morning axillary temperature is from 99° F. to 100° F. At this stage there is no clinical reason for supposing that the infection has reached the cerebro-spinal canal. In this connection it may be noted that Dr. R. G. Griffin (D.M.O., Uganda) has reported enlarged axillary glands, containing trypanosomes, in many cases where the cervical glands were not palpable. (*Trans. Roy. Soc. Trop. Med. and Hygiene*, Vol. xvii, Nos. 1 and 2, March and May, 1923).

Class B2 (early chronic).—The onset of nervous symptoms. The lymphatic glands may reach the size of a large damson, and microscopical examination of the gland juice often shows two or three trypanosomes in each field. The mental functions are much impaired. Tremors of the tongues and fingers are present and the knee-jerks are increased. The patient is often emaciated and suffers pains in various parts of the body, a dull headache being a prominent symptom. The morning axillary temperature is between 98° F. and 99° F.

Class B3 (late chronic).—The stage of incipient sleeping sickness. The patient is emaciated and has a harsh dry skin, while the lymphatic glands become sclerosed and smaller. (At times a bloated appearance is presented, but in these cases secondary infections and infestations may play a great part. ankylostomiasis probably ranking pre-eminent.) The male is usually impotent. The knee-jerks are increased and ankle-clonus is usually present and Romberg's sign is well developed. There is loss of strength and the gait is shuffling and unsteady. There is a marked somnolence and mental apathy and the temperature is usually subnormal.

Class C.—This stage represents the condition of true sleeping sickness. The patient is unable to stand, and has marked cerebral nervous symptoms, often being only semi-conscious. There is marked wasting and the knee-jerks may be absent, although Babinski's sign is usually obtained.

It is of course impossible to draw any hard and fast lines between the different stages of the disease, and a patient in any class may well be lacking in one or more of the signs described.

In other words, classification must be based upon the clinical picture as a whole.

Also, it is difficult to state definitely the length of time associated with the various stages suggested. The state described under " A " will only be diagnosed in those whose blood is examined in the first instance for the presence of *Spirilla* or the parasites of malaria to account for the raised temperature.

Possibly this stage lasts a considerable time, during which, we would suggest, the infection may die out naturally, the disease never having been recognized. This suggestion is supported by several observers reporting cases of trypanosomiasis which had no treatment at all and yet lived for prolonged periods.

Nattan-Larrier (French Congo, 1908) reports three Europeans living 17 months to three years, and Todd (1911) mentions five cases, four of whom were " alive and well " two to three years after diagnosis. None of these eight cases had any form of treatment.

On the other hand, Dr. G. C. Low and Dr. E. O'Driscoll report a case of trypanosomiasis from Nigeria in whose cerebro-spinal fluid trypanosomes were found five months after infection, indicating that what we have termed the B2 stage had then been reached. (*Transactions of the Royal Society of Tropical Medicine and Hygiene*, Vol. xv, No. 5, Nov. 17, 1921.)

We suggest, however, that from the B2 stage onwards the disease is beyond the possibility of a natural cure and gradually progresses, though to state exactly what stage has been reached is a purely arbitrary matter. For the " C " class patient the expectation of life is very short.

Except in the case of the " A " class patient (onset of infection, no gland enlargement), we believe that trypanosomes are rare in the peripheral blood-streams. We examined 30 untreated cases belonging to classes other than " A " without finding a single trypanosome in the blood.

In addition we sent 126 blood-films to Dr. Mary Martin, the assistant bacteriologist, Uganda, who, after exhaustive search, reported the presence of trypanosomes in 23 slides only. The suggestion that the visible presence of trypanosomes in the blood-stream is rare is supported by MacFie and Gallagher (1914), who report that no parasites were found in the peripheral circulation of 222 cases of trypanosomiasis examined in the Eket district of Nigeria.

This point is somewhat emphasized as it would appear to be of considerable importance as regards the spread of infection; for if trypanosomes are only found in the blood of early cases it may be presumed that this is the class of patient mainly responsible for infecting the fly, and consequently either patients of " A " class are much more numerous than is usually supposed, or else the number of human hosts necessary to spread the infection is very small.

It is, of course, realized that Miss Robertson found that the infectivity of the disease when transmitted by *Glossina* increased during the time that the less numerous short forms of trypanosomes we present, and diminished when the blood showed large number of parasites of the long type. (Mi Robertson, *Reports on the Sleeping Sickness Co mission of the Royal Society*, No. xiii.) This, ho ever, does not appear to afford an explanation view of the apparent absence of the trypanosom from the circulation of so many cases.

In the cases of treatment that we record, no " A or " C " cases have been included.

The treatment in Madi was based on the p sumption, itself based on our experience in Mba that the best results hitherto obtained have be those from intrathecal salvarsanized serum, and endeavoured to find answers to the follow questions:—

(1) Except in the very early stages (" A " cl patients) is a single intravenous injection of arsenical preparation sufficient to cure the infectio

(2) If serum is essential does it give as g results if the injection is intramuscular as when i intrathecal?

(3) Must such a serum be autogenous?

We also tried the effects of two drugs suggest by Dr. Shaw Mackenzie, viz., (*a*) pure curd so and (*b*) copper alanine.

In all 214 cases were treated by the vari methods indicated in our previous report, Febru 10, 1923, and are shown in the following table:

TABLE I.

(*Showing method of treatment adopted and number of case treated.*)

Treatment employed	Class of Disease B 1	B 2	B 3	T
1. Intrathecal serum following intravenous arsenic	7 ...	28 ...	13	
2. Intrathecal serum following intravenous " B "	1 ...	1 ...	2	
3. Intrathecal serum (as in 1 above) followed by intramuscular inactivated serum	2 ...	4 ...	1	
4. Intrathecal serum without intravenous injection	2 ...	1 ...	3	
5. Intramuscular serum following intravenous arsenic	11 ...	20 ...	9	
6. Intramuscular serum without intravenous injection	5 ...	23 ...	6	
7. As in 6 above, but followed by intramuscular inactivated serum	3 ...	2 ...	1	
8. Intravenous arsenic only... ...	4 ...	7 ...	3	
9. Intravenous " B " only	4 ...	6 ...	2	
10. Intravenous " A " only	2 ...	6 ...	4	
11. Intramuscular " A " only ...	4 ...	6 ...	1	
12. Intrathecal heterologous serum	2 ...	4 ...	1	
13. Intramuscular heterologous serum	1 ...	3 ...	0	
14. Intravenous arsenic followed by intravenous " A "	2 ...	1 ...	0	
15. Intrathecal heterologous serum, without intravenous injection ...	0 ...	1 ...	0	
16. Intramuscular salvarsanized serum (as in 5 above) followed by inactivated serum	1 ...	3 ...	2	
17. Intramuscular serum plus autogenous cerebro-spinal fluid ..	0 ...	1 ...	0	
	51 ...	117 ...	47	

In addition 45 patients were not treated but kept as contr

It is not necessary to give the results in gr detail, as except where the treatment compris intravenous arsenical medication, all cases sho

00 per cent. positive results when re-examined fter 12 months.

Cases which had received intravenous arsenic as art of the method of treatment gave the following esults after 12 months:—

TABLE II.

(1) Intravenous arsenic alone. (Treatment, 8.)

	B 1 Per cent.	B 2 Per cent.	B 3 Per cent.
ositive or dead	50 ...	43 ...	100
ive and well	50 ...	57 ...	0

(2) Intramuscular salvarsanized serum. (Treatment, 5.)

	B 1 Per cent.	B 2 Per cent.	B 3 Per cent.
ositive or dead	50 ...	60 ...	63
ive and well	33 ...	30 ...	27
ot seen	16 ...	10 ...	10

(3) Intrathecal salvarsanized serum. (Treatment, 1.)

	B 1 Per cent.	B 2 Per cent.	B 3 Per cent.
ositive or dead	33·3 ...	28 ...	35
ive and well	66·6 ...	56 ...	50
ot traced	— ...	15 ...	14

After 22 months only 25 cases of all the 214 atients treated by various methods were found to e alive and well, but it is interesting to note that f these 25 cases no less than 20 had been treated y intrathecal serum.

As these figures were anything but satisfactory, e felt called upon to indite our letter to the *British Medical Journal* previously referred to, stating that ntrathecal salvarsanized serum had not given the esults we hoped for, and had not furnished any eplies to the questions we set ourselves to answer.

On the other hand, the patients treated in the Mbale district were re-examined in September, 924, and the following table shows the results btained:—

TABLE III.

No. of case	Months since treatment commenced	Remarks
2 ...	72 ...	Well[1]
4 ...	68 ...	Well
7 ...	58 ...	Well
8 ...	60 ...	Well
11 ...	42½ ...	Died of dysentery June 10, 1923
12 ...	57½ ...	Well
13 ...	57½ ...	Well
15 ...	57½ ...	Well
16 ...	46 ...	Relapsed, found positive February 4, 1924
17 ...	53 ...	Well
18 ...	? ...	Reported dead
19 ...	53 ...	Well
20 ...	43 ...	Died November 14, 1923
21 ...	53 ...	Well
22 ...	53 ...	Well
23 ...	53 ...	Well
24 ...	53 ...	Well
25 ...	35 ...	Died March 8, 1923
27 ...	52½ ...	Well
29 ...	52½ ...	Well
30 ...	50½ ...	Died August 31, 1924
32 ...	51½ ...	Well
46 ...	48½ ...	Well
55 ...	45½ ...	Well
60 ...	42 ...	Well
61 ...	42 ...	Well

Case 26 treated 52½ months ago, was not seen but is reported alive and well.)

[1] "Well" indicates that the patients showed no clinical igns and gland puncture and blood examination proved egative.

That is to say, of the 27 cases reported up to February 31, 1922 (*vide British Medical Journal*, February 10, 1923, and examined again in September, 1924 (S.M.V.), five had died and one case relapsed, while 21 remain alive and well and showing no signs of trypanosome infection on clinical and microscopical examination, although from 3½ to 6 years have elapsed since they were found to be infected, and they have received no treatment other than the one intrathecal injection of salvarsanized serum.

The worst construction has been placed on these figures, as in one case death is known to have been due to disease other than trypanosomiasis, and in no case was death proved to have been due to this cause.

Further, some patients were liable to re-infection, and one case was noted for especially careful watching as he was actually working in the sleeping sickness area.

Considering the very marked difference in the success of similar treatment in these two districts, we naturally endeavoured to find some explanation as to why better results were obtained in the Mbale than in the Madi area.

The first suggestion which occurred to us was that the trypanosome was more virulent in Madi than in Mbale, but this does not appear to be so, for the following reasons:—

(1) A number of cases of trypanosomiasis at Mbale were treated by methods other than by intrathecal serum.

TABLE IV.

No. of case		
7	Relapsed	
14	Well	
28	Well	All early cases
31	Well	
34	Dead	
35	Relapsed	
36	Not traced	
56	Died	
57	Not traced	
58	Well	
62	Relapsed	
63	Relapsed	
64	Died	
65	Died	
66	Died	
67	Died	
68	Relapsed	

Out of seventeen cases four are found to be alive and well, eleven are either dead or show trypanosome infection, and two cannot be traced.

(2) Rats subinoculated by one of us (S.M.V.) from the blood of patients in Madi, showing rapid progress in the disease, ran a normal course of infection, parasites not being found in their blood for 9-12 days, and the rats remaining alive, comparatively well, until they were destroyed three weeks later, during the whole of which time their blood continued to show trypanosomes.

We would suggest, however, that two factors may be of paramount importance.

(i) The nature of the fly infestation of the two areas.

In the Mbale district the source of the trypano-

some infection is from the shores of the Mpologoma river, part of which has been thoroughly cleaned and is constantly supervized by a European sleeping sickness inspector, while other parts have, for administrative reasons, been left alone. As a result, many cases of trypanosomiasis after treatment have returned to live in a fly-free area, although others have been exposed to the risk of re-infection.

In Madi, on the other hand, the whole country is remarkably honeycombed with small streams, all potential and, in the great majority of cases, actual harbourers of *Glossina palpalis* and *Glossina morsitans*, which abound over the whole district, and consequently there may be a constant infection of sound individuals combined with a continual re-infection of those already suffering from the disease. The conditions closely resemble those described by Hodges as existing in the Lake Victoria Nyanza area during the great epidemic of 1906-1909, except that the actual dwelling places are out of reach of fly.

(ii) The second factor is the widespread prevalence of infections by debilitating diseases, such as yaws, syphilis, ulcers, guinea-worm, and especially intestinal parasites, in the Madi district.

One of us (S.M.V.) examined the stools of 35 unselected natives, with the results shown in the following table, these figures being the more striking when it is noted that the stools which were found negative had been brought on a leaf for examination and were several hours old and dried up:—

TABLE V.

Ankylostomes present in	63	per cent.	of	all cases	examined.
Ascaris	,, 26	,,	,,	,,	
Tænia	,, 14	,,	,,	,,	
Trichostrongylus	,, 11	,,	,,	,,	
S. mansoni	,, 6	,,	,,	,,	

The fact that only a limited number of stools and fresh preparations of blood were examined in the field was due to the exigencies of the tour, and while such limited numbers cannot be conclusive, the results obtained are very suggestive.

We therefore suggest that the marked mortality of the disease in the Madi, as compared to the Mbale district, is due to:—

(1) A repeated superimposed infection from continuous exposure in fly-infested areas.

(2) The possible debilitating influence of intestinal parasites, of which the ankylostome is of primary importance.

Finally, since we still believe that, apart from such conditions as exist in Madi and possibly elsewhere, intrathecal serum has given the best results as regards treatment, we endeavoured to obtain a true comparison of its effects by treating a series of cases at Mbale with (1) Bayer "205," and (2) tryparsamide:—

	B 1	B 2	B 3	
Bayer "205":—				
Alive and well ...	3 ...	3 ...	1 ...	7
Relapsed ...	1 ...	— ...	4[1] ...	5
Tryparsamide:—				
Alive and well ...	7 ...	4 ...	2 ...	13
Relapsed ...	— ...	1 ...	3 ...	4
Not traced ...	— ...	1 ...	1 ...	—

[1] Two cases treated by Bayer "205" were subsequently found still to show trypanosomes and were retreated by tryparsamide, when the parasites disappeared.

From the limited number of cases and the short time which has elapsed since treatment was commenced no definite conclusions can be drawn, but it would appear that tryparsamide gives considerably better results than Bayer "205," and that neither shows any superiority over intrathecal serum.

Recent teaching in the Edinburgh V.D. clinic traces the value of tryparsamide in parasyphilitic cerebro-spinal lesions to its passage into the cerebro-spinal fluid. This, in our opinion, explains its superior therapeutic action over the other drugs and would support our contention that in the more advanced stages of trypanosomiasis intrathecal medication is essential.

The principle involved is identical except that by the injection of intrathecal serum we hoped to obtain sterilization of the cerebro-spinal fluid through the introduction of "antibodies" and complement.

As we have previously pointed out, any treatment involving a series of injections over a considerable period is contra-indicated in dealing with natives.

Several patients who were treated with Bayer "205" or tryparsamide ran away as soon as their condition improved, without completing the course, and these could not be included in the results detailed above.

Also no comparison can be made between the treatment of European patients in England and the treatment of natives on a large scale in Africa, since the native, unless he is seriously ill, will not stay in hospital or continue treatment once he feels better.

Patients of Class "A" are therefore hardly ever diagnosed among natives, while in the majority of Europeans the disease is discovered in its early stages. This is a factor which can only be eliminated by the education of the native, and such education can only be effected by an efficient medical staff and abundant hospital facilities for all natives who present themselves for treatment of any form of disease.

In concluding this report of our observations and experiments in connection with the treatment of trypanosomiasis, we contend that in describing the results of treatment of trypanosomiasis it is essential to distinguish the different stages of the disease, as early cases may very possibly be cured by many forms of intravenous medication and may even undergo a natural cure.

Finally, we consider it would be of interest to follow up and note the final results of the treatment of cases at Mbale by Bayer "205" and tryparsamide after at least as long a period as has been possible in the cases treated by intrathecal serum, so that any inference or conclusions drawn thereupon may be comparable.

We would also point out the possibility that such factors as superimposed infection, and also secondary infections (especially of intestinal parasites such as ankylostomes), may interfere with the normal course of any form of treatment.

We wish to thank Dr. J. Hope Reford, R.A.M.C.,

Uganda, for permission to publish this report, and also all those who have helped us in our work, more particularly Captain R. P. Rawson, M.C., late D.M.O., Uganda, and Dr. Mary Martin, Assistant Bacteriologist, Uganda, and Professor John Eyre, of London University, for his criticisms and advice.

REMARKS ON CLAYTON-LANE'S CRITICISM OF MY MONOGRAPH ON MALARIA AND BLACKWATER FEVER IN THE *TROPICAL DISEASES BULLETIN*, 1925, VOL. 22, NO. 4, P. 338.

By H. Ziemann, M.D.

Professor of Tropical Medicine, Berlin.

Criticism may, and indeed should, be severe. It should, however, be just and fair, and based upon facts capable of proof, and not on mere assertions.

(1) The epidemiologic curves of fever in Italy on p. 152 are based, as the text indicates, on the well-known investigations of Celli on the epidemiology of malaria in Italy.

(2) The epidemiological curves in the Cameroons on p. 137 are based on the exact clinical and hæmatological investigation of individual cases. There is no mention of uncertainties.

(3) I have seen cases of recurrence in cases in which gametocytes are present in the peripheral blood, and have explained, not only on p. 307, but also in other places, that other authors (e.g., Nocht) have observed gametocytes also in fresh cases (cf. section on parasites). Wherefore the observations of Warrington Yorke and Macfie, who first found schizonts and then two to three days later found gametocytes in the peripheral blood in new cases, which many sections of my book make objectless, are quite undiscoverable by me.

(4) In many places I have pointed out that the sequels which occur in the inoculated malaria in paralytics cannot without further investigation be applied to the naturally acquired malaria and considered as proved.

(5) Clayton-Lane has not in the least understood my views on the problems of the direct or indirect action of quinine on the parasites (pp. 338 and 356). Compare also Jacues, *Trop. Dis. Bull.*, vol. 14, p. 71.) They are supported by observations on malarial blood after the administration of quinine, and also by the extensive investigations of Retzlaff, p. 364.

(6) He also appears not to have read the sections on quinine injections (intramuscular), wherein I carefully discuss the pros and cons.

(7) Nor does Clayton-Lane completely grasp the chapters on quinine resistance, that a fall in quinine resistance also occurs in cases in which quinine resorption has undoubtedly taken place.

(8) The nomenclature of the parasites is fully explained in the chapter which deals with the parasites.

(9) The circumstance that in one place by a printer's error Delhi is changed to Deli is seized upon by Clayton-Lane as evidence that the credibility of the views in other connections is unreliable. A condition which cannot be obviated by earnest scientists and critics is the seizure, when proof cannot be adduced, of trivialities and inaccuracies. Consciousness and the impartial compilation of works free from transitory errors is recognized, compare, e.g., the criticisms of Grasso in *Il Policlinico* and many others. I cannot, therefore, accept the criticism of Lane as a just and fair one.

ENVIRONMENTAL INFLUENCES WHICH FAVOUR THE DEVELOPMENT AND SPREAD OF THE BILHARZIA PARASITE IN SOUTH AFRICA. FOOD SUPPLY OF "PHYSOPSIS."

By F. G. Cawston, M.D. (Cantab.).

The Presence or Absence of the Intermediate Hosts of Schistosome Parasitic Worms in any Locality Depends upon the Food Supply.

In the Union of South Africa it will depend very largely upon the presence or absence of a common rush of Natal rivers, found also in various parts of the Cape, Transvaal and Free State and existing also in Portuguese East Africa, *Cyperus immensus* C. B. Clarke, for this is the favourite food of *Isidora africana* (Krauss), popularly known as "Physopsis," which is the only common carrier of schistosoma in South Africa.

The plant is found in swampy areas, where, unfortunately, it tends to collect an extraordinary quantity of waste-paper from the homes of Natal Indians, natives and poor whites, who purchase most of their food supply in paper packages, only a proportion of which finds its way into the holes that are dug for rubbish. Incinerators, so well adapted to institutions, are perhaps too expensive to recommend for poorer householders, and the burning of rubbish has its dangers where many children are living in crowded dwellings.

This plant grows abundantly along the banks of a pool at Sydenham, where the vast majority of bilharzia patients in this district have acquired the disease. The pool is about eighty yards long and thirty yards broad. It is particularly the decaying leaves on the surface of the water which harbour examples of *I. africana* and are likely to show the golden jelly containing the eggs. During the dry season accumulated rushes can be burnt, cut down or dug out. The natives gather them and use them for making baskets and mats. *C. immensus* C. B. Clarke might be cultivated for industrial use; but the plant should not be allowed to grow near stagnant water, or where there is the risk of its decaying leaves being carried down-stream. In view of its tendency to encourage the accumulation of rubbish, it should not be grown too close to human dwellings. Fresh-water shells as large as those of *I. africana* are not found in the smaller spruits; nor are they found in marshy areas,

except when they have been carried there in the water that overflows from the flooded river.

I. africana is found less frequently attached to the leaves of the common water hyacinth, *Eichhornia crassipes* (Ponteder) or to floating wood and sugar-cane.

I. africana is also commonly attached to the under-surface of the leaves of the "Blue Lotus," *Nymphæa stellata*, or to some of the stalks, where its eggs may easily be differentiated from those of *Limnæa natalensis* Krauss, the intermediate host of *Fasciola gigantica* Cobbold; because the latter are laid in colourless jelly.

My repeated experiments would seem to show that, whilst examples of *I. africana* seldom fail to become infested, when miracidia of *Schistosomum hæmatobium* are allowed access to the water, *Limnæa natalensis* remains free from bilharzia infection. This observation is in conformity with my experience of *Limnæa* in nature; but it is contrary to that of Dr. Annie Porter, who reports the successful development of *S. hæmatobium* in examples of *Limnæa natalensis* at the South African Institute for Medical Research in Johannesburg.

A careful investigation of the favourite foods of various fresh-water snails is essential to those who attempt to breed them successfully in artificial surroundings.

Where collections of water are known to be infested with the bilharzia and liver-fluke parasites, every effort should be made to clear out the roots of the these common water-lilies and, wherever the lilies are grown, every endeavour should be made to keep them clear of fesh-water snails. In the valley between the two hills at the Bluff, Durban, the "blue lotus" grows extensively, but I do not find any trace of *I. africana* there, nor does this swampy area appear to be conducive to the breeding of this species, and I do not know of any cases of bilharzia infection amongst the numerous Indian children who live in that district.

The dwellings lie close to pools very favourable to the growth of fresh-water snails in the Durban suburbs. A large proportion of these snails harbour schistosomes, and a history of present or past symptoms of bilharzia disease can readily be obtained in most of the neighbouring houses; though it is less frequent amongst the Mohammedans who do not allow their children to hang about the pools. It should be noted that the earlier symptoms of schistosome invasion are sometimes mistaken for malaria in Natal.

The outbuildings, which have been erected so close to the Sydenham pool, are provided with the bucket system. These buckets are said to be emptied three times a week at a cost to the householder of 1s. 6d. a time. I have not examined microscopically the contents of these buckets; but, with so large a number of bilharzia cases in the district, the probability is that they contain the ova of schistosoma, and children with severe hæmaturia sometimes pass their urine among the rushes at the side of the pool. Many Indians have been born in Natal or have migrated to Natal to live amongst the old indentured Indians, and every year sees an increase of their dwellings amongst the natives and the poorer class of European in the Durban suburbs; the vast majority make too little money to enable them to live in much comfort. Although 90 per cent. of the Mohammedan male folk read and speak English fluently, their wives are illiterate, and the vast majority of Indian children are insufficiently intelligent to grasp the significance of a chronic hæmaturia, which so often tends to disappear, more particularly during the winter months.

Durban is very largely dependent on its Indian population for its popular vegetable and fruit supply. This is grown either on Indian property or by Indians in European gardens. It is gathered in the afternoon and stored overnight, being carried in carts driven by Indians to the market in the early hours of the day. At the Indian market a large number of Europeans purchase the daily supply for boarding houses and hotels. Throughout the day Hindu hawkers are to be seen carrying their baskets on bamboo poles round to European houses for the sale of their fruit and vegetables.

Lettuce and kindred vegetables are sometimes gathered and thrown into a pool overnight. I have found such floating vegetables, including the leaves of beetroot, on the surface of the Umbilo River where fresh-water snails breed close to a vegetable garden. Vegetable contamination would seem to have been responsible for bilharzia infection in a child of four who had been protected from other risks of infection.

I have previously drawn attention to the great accumulation of fresh-water snails, particularly *Melanoides tuberculatus* Müller, in the Durban water-cress beds. Although *I. africana* does not breed there, many of the snails are infested with those cercariæ which can encyst on green food. I am glad to note the increased number of well-constructed bore-holes for the supply of water in the Indian quarters; but infested examples of *I. africana* (Krauss) and allied snails are still readily obtainable throughout the Durban suburbs.

Occasionally I find large examples of *I. africana*, less commonly *Limnæa natalensis*, attached to floating cattle manure. The chances of fresh-water snails becoming infested from the miracidia which escape from fæcal material are evident under these conditions; for although the ova of *Fasciola* would appear to take about eighteen days to hatch, the ova of schistosomes hatch out very rapidly in water. The intermediate hosts of trematode parasitic worms are attracted to the surface of a pool by decaying vegetable matter and by the food waste of man and cattle, as is evidenced by the number that are found in such places as a pool below a railway location, a stream below an abattoir, those portions of a river close to the drift where natives or Indians wash their clothes, and marshy land where cattle wade.

In October, 1925, I injected two guinea-pigs with a large number of bifid-tailed cercariæ from *I. africana* collected from the Sydenham pool. No abnormality was detected post mortem in either animal when dissected three months later. How-

er, I fed another guinea-pig on some food con-
ining cercariæ from the same source on October
and 14 and secured about fifty male and female
ult schistosomes from its portal system on
ecember 20, when I also observed a thickened
er-substance and a rather severe ascites. In
ct the animal was dying from ascites when I
crificed it. I have never noted ascites in a bil-
rzia patient in Natal, but this may become
mmon if cases of *Schistosomum mansoni* con-
ue to increase.

I. africana (Krauss) at Durban shows variation
the height of the spire and in the character of
e whorls, as is common in some other species of
is remarkable genus. So great is the variation
some of the species, such as *Isidora tropica*
(rauss) and *Isidora compta* (M. and P.) that one
grets that the term "interspecific hybrids"
ould have been applied to any cercariæ carriers
nong these polymorphous species.

However, *I. africana* (Krauss) may readily be
stinguished from *I. tropica*, *I. natalensis* and
compta, because of the truncate columella of
s shell. This columella may also vary to some
tent and, for this reason, it is sometimes diffi-
lt to tell some examples from those of *Isidora*
Physopsis) *globosa* Morelet, which is a common
rrier of bilharzia infection at Lourenço Marques
nd is said to occur in Natal. The pools from
hich I obtained examples of *I. globosa* infested
ith schistosomes at Lourenço Marques in 1922
ontained numerous examples of the "blue lotus"
nd a thick growth of the broad rush which is so
vourite a food of *I. africana*.

Both *Cyperus immensus* and *Nymphæa stellata*
ccur in the lagoons that are formed at the mouth
f some Natal rivers; but the occasional presence
f sea-water in lagoons prevents an accumulation
f fresh-water snails in any considerable numbers.

In view of the well-known value of sea-water in
estroying the infection of rivers, the local health
uthorities of a Transvaal village were considering
he establishment of a salt-water swimming bath
ontaining 1 in 10,000 of common salt. Such diluted
aline encourages the activity of the bilharzia para-
ites and is favourable to the breeding of their
ntermediate host, and I welcomed the opportunity
f warning them of its danger before the scheme
ad been put in hand and had provided a false
ense of security in an infected locality.

Conclusions.

(1) Pools containing the decaying leaves of the
road rush and the blue lotus are very favourable
o the breeding of the molluscan intermediate
osts of schistosomes, and the mere presence of
ater-fowl cannot be regarded as unfavourable to
he spread of bilharzia infection. So long as these
irds are on the wing, they have access to so large
variety of suitable food supply that only a small
proportion of fresh-water snails are devoured, and
the most mature examples with large shells, which
are the most likely to be infested with cercariæ,
are very likely to escape.

Nevertheless, I have repeatedly observed that similar pools are kept almost clear of fresh-water snails, so long as they contain domesticated duck whose molluscan food supply is limited to what exists in these pools. Generally speaking, the environmental influences which are favourable to wild-fowl are favourable to fresh-water snails, and the control of the intermediate host of *Schistosomum hæmatobium* Bilharz depends rather upon the removal of the decomposing leaves of *Cyperus immensus* C. B. Clarke and those of *Nymphæa stellata* from running water. Fresh-water snails harbouring the cercariæ of *Schistosomum mansoni* Samson often feed on these plants; but they are more commonly found in localities where there is much surface vegetation, such as water-cress, and where they are exposed to fæcal contamination in shallow water.

(2) Those portions of streams which are frequented by man and beast are specially liable to show an accumulation of fresh-water snails, as food waste assists in creating an environment favourable to their breeding and growth.

(3) If *Schistosomum japonicum* could be eradicated from human beings in China and Japan, it might still continue to exist in dogs and oxen; if it were possible to eradicate *Fasciola hepatica* from sheep and oxen in Australia, this parasite would still have the rabbits to use as a reservoir host, as it does to-day in New South Wales. As schistosomes are not known to exist in any animals in South Africa, it is probable that these parasites might be very largely exterminated from the Union, if intelligent efforts were made to cure all human beings who are known to be infested, and the problem of the infection of streams by bilharzia carriers bravely tackled by the public health authorities; for, without the human hosts to assist in the spread of the disease, the country would not harbour influences favourable to its continuance.

The Production of Persistent Alopecia in Rabbits by X-Rays of Various Degrees of Hardness (Harry Clark, Ph.D., and Ernest Strum, *Journal of Experimental Medicine*, October 1, 1925).—The minimum of doses of X-ray, of each of three degrees of hardness, required to produce persistent alopecia of the abdominal skin of normal white rabbits, has been studied. 40 kilovolt rays filtered by 0·5 mm., 50 kilovolt rays filtered by 1 mm., and 70 kilovolt rays filtered by 1·5 mm. of aluminium, were employed. The 70 kilovolt work is unfinished. Under constant conditions of treatment the animals were found to react with a high degree of consistency. The values of the critical minimum doses expressed in terms of ionization (pair of ions per grm. of air divided by 10^{15}) for rays produced at 30, 40, 50 and 70 kilovolt peak, are 2·04, 3·7, 4·5, and over 5·1 respectively. The 30 kilovolt value is taken from a previous paper. It is shown that the alopecia reaction does not run parallel to the erythema and pigmentation reactions.

Notices.

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THE DIETETIC THEORY OF PELLAGRA.

PELLAGRA has been defined as an endemic disease, usually of long duration and of unknown causation, which is characterized by cutaneous, gastro-intestinal and nervous symptoms, which undergo exacerbations at recurrent intervals, usually in the spring and autumn.

It was first described by Gaspar Casal in northern Spain as long ago as 1735. His description of the condition, which was known to the vulgar under the name "Mal de la Rosa," was accompanied by a representation of the disease clearly showing the eruption round the neck and down the front of the chest (constituting Casal's necklace) and on the dorsa of the hands and feet. Early in the eighteenth century the disease seems to have been well known in Italy, and it is in that country that the disease has since been best known and most intensively studied. It is, however, very widespread in its distribution, and it is highly probable that before many years have passed, pellagra will be found to be prevalent over the whole surface of the globe. At the present time it is very apt to be overlooked in England and Scotland and in America.

As long as the disease has been known food has always been under suspicion as being a most important factor in its ætiology, and since the area of distribution of the disease in Europe coincided with the districts in which maize constitutes the principal element in the food supply of the people, this substance has often been credited with playing an important part in the production of pellagra. The dietetic theory is still strongly held, and shares with the parasitic or infective theory the views which at present prevail as to the ætiology of the disease. There are very varied opinions as to the precise way in which the disease is produced by maize, and several theories as to its mode of action have at various times held the field. Thus, there is the toxic theory, according to which pellagra is due to the action of toxins produced by or in the maize, it being variously held that the normal grain possesses toxic properties or excites an anaphylactic reaction; that toxins are produced during spring by the germination of the maize; that toxins are generated in the bowel from the grain by the action of *Bacillus coli communis;* and that toxins are produced in fermenting or mouldy maize by the action of many varieties of fungi and bacteria. Another view is the photo-dynamic theory, according to which photo-dynamic substances are elaborated and introduced by maize and other cereals into the blood and become toxic under the influence of sunlight. Again, there is the deficiency theory, according to which the maize protein zein is incomplete in nutrient properties owing to the absence of the amino-acid tryptophane, and in this theory pellagra would be due to a deficiency of tryptophane in a diet composed largely of maize.

Closely allied to this theory is the view of Goldberger that pellagra is solely due to a deficient and unbalanced diet, as he produced the disease experimentally by feeding a group of selected persons on a diet consisting largely of corn-meal, grit, potatoes, fat meat, syrup and sugar—a diet very similar to that of many of the poor, both black and white, in the rural districts of the southern States of North America, where pellagra abundantly prevails

Further, by improvement in the diet of pellagrins the mortality from the disease has been greatly lowered and the time of convalescence considerably shortened.

To Funk we probably owe the view that pellagra is due to a vitamin deficiency and is to be classed as similar to beriberi. McCarrison showed that vitamin C serves to protect the gastro-intestinal tract from infection, and that the deleterious effects of a deficiency of this vitamin is enhanced when the food is improperly balanced, particularly when associated with an excess of carbohydrates or of fats, or of both, in the food. The diet employed by McCarrison in his experiments on monkeys, being deficient in vitamin C and excessive in carbohydrates and fats, is very similar to that employed by Goldberger used in producing experimental pellagra in human beings; but McCarrison insists that faulty food lowers the resistance of the gastro-intestinal tract to infections, whereas Goldberger contends that an unbalanced diet is the sole cause of pellagra. McCarrison, too, was at first inclined to the belief that pellagra is solely a deficiency disease, but later promulgated the view that improper diet is merely a predisposing factor, and that some sort of infection is the exciting cause of the disease.

Seale Harris has pointed out that if faulty food were the only factor in the production of pellagra, it would seem that the countries of Europe, that suffered so much from a lack of meat, milk and eggs during and after the Great War, would have been scourged with pellagra. Notwithstanding the unbalanced and deficient diets during the war in France, Belgium, Germany and Austro-Hungary, pellagra did not prevail in these countries, whilst in Italy there has been so great a reduction in the prevalence of pellagra that it has now become a comparatively rare disease in that country. We must therefore agree with the conclusions to which Harris has arrived, namely, that the cause of pellagra has not been discovered and that an unbalanced diet does not seem to be the only factor in the ætiology of pellagra; that a diet low in vitamin C and unbalanced by an excess of carbohydrates lowers resistance and is an important predisposing cause of pellagra; that a full diet rich in vitamins and a low carbohydrate content is essential in the treatment of pellagra; and that it is due to an infection is probable, especially in individuals whose resistance has been lowered as the result of a deficient or unbalanced diet.

F. E. T.

Annotations.

Non-pathogenicity of the Milkweed Flagellate in Maryland (Francis O. Holmes, *Phytopathology*, May, 1925).—*Herpetomonas elmassiani* (Migone) may be present in the latex of the milkweed, *Asclepias syriaca* L., in very large numbers without appearing to interfere with the normal growth of the plant or to modify the leaves, stems, or seed pods.

The Employment of Carbon Tetrachloride followed immediately by Magnesium Sulphate in the Treatment of Uncinariasis (Clark H. Yeager, M.D., *Transactions of the Royal Society of Tropical Medicine and Hygiene*, October 15, 1925).—The simultaneous administration of magnesium sulphate with carbon tetrachloride has very little effect in reducing the anthelmintic power of the drug, and reduces to a minimum the liability to the production of toxic symptoms. The adoption of this technique in favourable circumstances will effect a great saving of time in mass treatment work, and under certain conditions may make all the difference between the possibility and impracticability of carrying on the hookworm campaign. This technique is more likely to be favoured by the patients on account of the fact that they will not have to wait so long for their first meal as they would have to do with other methods of administering the treatment. In Mauritius this technique has been of no practical use in the treatment of infections by ascaris or trichuris. It is advisable to give or recommend a laxative, when necessary, on the day following treatment, to ensure the early evacuation of dead worms.

Curative Effect of Bismuth Compounds in Experimental Rabbit Syphilis (G. W. Raiziss and M. Severac, *Archives of Dermatology and Syphilology*, November, 1925).—Potassium bismuth tartrate and bismuth compounds in general are much less toxic intramuscularly than intravenously. On the basis of prolonged observations and the method of popliteal node transfer, the authors found that bismuth compounds are powerful enough to cause complete eradication of infection in experimental rabbit syphilis. Arsphenamin and its derivatives have higher chemotherapeutic indexes than bismuth compounds. The latter are distinctly superior to mercury. Because the low toxicity of arsphenamin derivatives permits the intravenous administration of massive doses, they remain the basic remedies in the treatment of syphilis, bismuth compounds taking the next place.

Mycosis Fungoides. Its Relation to Leukemia and Lymphosarcoma (J. Frank Fraser, M.D., *Archives of Dermatology and Syphilology*, December, 1925).—Two cases are added to the growing number of instances of mycosis fungoides in which the pathologic changes in the tissues are unquestionably neoplastic. Evidence is presented which shows a genetic relation between mycosis fungoides, lymphatic leukæmia and lymphosarcoma. The name reticulum cell sarcoma is suggested to replace the term lymphosarcoma in describing the lesion of mycosis fungoides. The suggestion is based on the assumption that the lesion has its origin in the reticulum cells of the papillary layer (reticulo-endothelial system of the skin).

The Effect of Ancylostome, Ascaris, and Trichuris Infections on the Health of the West African Native (R. M. Gordon, *Annals of Tropical Medicine and Parasitology*, December 16, 1925).—A study of the effects of ankylostomiasis on the health of the West African natives, and those of *Ascaris* and *Trichuris* on eighty-nine of the same cases has shown that these infections or a combination of these infections, produce no noticeable effects on the hæmoglobin percentage, the physique and general fitness, or the mentality of the cases examined, nor is their presence in any way associated with albumin or casts in the urine. *Ascaris* and *Trichuris* infections do not appear to be more associated with a low standard of energy than one of a higher standard. On the other hand, the figures suggest the possibility of some association between ankylostome infections of more than 15,000 ova per grm. of fæces, and the low standard of energy observed in such cases; but only a few such intense infections were observed, and it is obvious that in order to justify any such definite conclusion the work must be repeated with very much larger groups of cases. It therefore follows from these conclusions that before treatment, and especially before the so-called " mass treatment " of ankylostomiasis, is applied to any native race, careful investigation should be made whether ankylostomiasis has any definite pathogenic effect on that race, and if pathogenic effects are noted, with what degree of infection they are associated.

Erythrocytosis in Artificially-inoculated Malaria (G. de M. Rudolf and J. C. Ramsay, *Annals of Tropical Medicine and Parasitology*, December 16, 1925).—In four cases of general paralysis inoculated with benign tertian malaria an erythrocytosis was found to precede the anæmia. The erythrocytosis occurred whether the inoculation was performed by means of mosquitoes or by subcutaneous injection of malarial blood. It was independent of the sex of the patient and of a history of previous malaria. The succeeding anæmia occurred, or persisted for several days after the cessation of the fever. Regeneration of the red cells was complete within three weeks, although the degree of anæmia was very different in the four cases. An erythrocytosis was found to follow the anæmia. The hæmoglobin was found, in two cases, to vary with the red cells, but regeneration was less rapid. The colour-index was, as a rule, of the secondary anæmia type. At certain periods it became as low as 0·5. In two cases the number of parasites was found to vary approximately with the degree of fever, although the number of parasites was very different in the two cases.

Anti-rabic Procedure in Palestine with Special Reference to Decentralization of Treatment (G. Stuart, M.A., M.B., and K. S. Krikorian, M.D., *Annals of Tropical Medicine and Parasitology*, December 16, 1925).—Carbolized anti-rabic vaccine is an efficient and safe treatment for persons bitten by rabid animals. It can be manufactured without additional staff in any well-equipped laboratory. It can be distributed to any number of treatment centres where as good results attend its use as at the place of its production. Better results have followed the employment of a dosage of 5 c.c. daily of 1 per cent. emulsion, over a period of fourteen days, than of 2 per cent. of the same emulsion over the same period. Carbolized vaccine is most practicable in the curative and prophylactic treatment of farm animals. It can be easily administered in rural districts by veterinary officers. It is a great advance on older methods of treatment in the wideness of applicability and economy of production of the vaccine. It is at once the most economical and utilitarian mode of treatment. Bitten persons can be treated at or near their own homes, and thus—the all-important consideration of immediate treatment aside—they are spared the expenses connected with travel to, and residence in, a strange town.

Stool Examination for Protozoa (Walter S. Thomas, M.D., and E. A. Baumgartner, M.D., *Journal of the American Medical Association*, November 28, 1925).—In 1,122 inmates of a New York State institution, 44·47 per cent. showed intestinal protozoa on examination of a single stool specimen from each. There is evidence of cross infestation in the institution. The influence of age is not great except in the case of *Giardia lamblia*, in which the young persons are more often infested. *Chilomastix mesnili* was the organism most often found. *Endamœba histolytica* was seen in only 1·97 per cent. of those persons examined. Taking this low figure into consideration, together with the facts that we are dealing with a class of patients in which a high incidence might be expected, that the patients were all confined in an institution where cross infestation takes place, and that none of the 1·97 per cent. with *Endamœba histolytica* had at any time shown evidence of amœbic disease, we feel justified in believing that *Endamœba histolytica* plays only an insignificant rôle in the production of disease in New York State.

A Study of Hemolytic Streptococci in Acute Rheumatic Fever with an Analysis of the Antigenic Relationships existing among certain Strains (Christopher H. Andrews, M.D., Clifford L. Derick, M.D., and Homer F. Swift, M.D., *Journal of Experimental Medicine*, January 1, 1925).—Thirteen strains of hæmolytic streptococci isolated from patients with acute rheumatic fever did not show any evidence of being related serologically. Strains of hæmolytic streptococci exist which, although identical by the agglutination test, do not show complete reciprocal agglutinin absorption. Sera

prepared from such related strains may show some protective power in mice against another member of the group. Some strains of hæmolytic streptococci may absorb agglutinins from a serum prepared against another strain, and yet may fail to be agglutinated by that serum. None of twenty strains of hæmolytic streptococci isolated in New York City in 1924 and 1925 corresponded serologically with Dochez, Avery and Lancefield's 4-type strains or with Gordon's Type I strain.

The Incidence of Pulmonary Tuberculosis in Colombo as Indicated by an Examination of Sputa found in Public Places (R. de Silva, *Ceylon Journal of Science*, Vol. 1, Part 3, November 18, 1925).—In the streets and public places of Ceylon two types of sputa are to be seen scattered widely, one a reddish brown liquid which is ejected by the numerous chewers of "betel"; the second type is gelatinous, derived principally from bronchiole secretions brought up from the lungs. 148 specimens of the latter type were collected for examination for *Bacillus tuberculosis*. 3·8 per cent. were found positive for this organism. Many of the specimens contained numerous streptococci and diphtheroids, and in one case a specimen was seen to be teeming with spirochætes indistinguishable from the spirochætes of Vincent's angina.

The Treatment of Hookworm and Ascaris Infections with Carbon Tetrachloride and Oil of Chenopodium (W. C. Sweet, *Ceylon Journal of Science*, Vol. 1, Part 3, November 18, 1925).—The most efficient treatment tested for removing hookworms was a combination of carbon tetrachloride and oil of chenopodium, in a ratio of three to one, given in a solution of magnesium sulphate for a purge. This combination was also highly efficient in removing ascarides, although the giving of the salts two hours after the anthelmintic increased the efficiency in removing these worms. In a country where infection with *Ascaris lumbricoides* is widespread, the combination treatment given in the purge of magnesium sulphate will be a better routine measure than either of the anthelmintics given alone. In the series of treatments reported no decided preferential action on hookworms of either sex could be determined.

The giving of salts with the anthelmintic apparently delayed the expulsion of the majority of both hookworms and ascarides until the second day following treatment, but increased the efficiency of the trial treatment in removing hookworms. The degree of infection with hookworms was found to have some effect on the efficiency of trial treatments, the highest efficiency being found in groups with from 51 to 200 worms each. Infections with smaller and larger numbers of worms did not show as high an efficiency for trial treatments.

Hookworm Re-infection. An Analysis of 8,239 Ceylon Egg-counts (W. C. Sweet, *Ceylon Journal of Science*, Vol. 1, Part 3, November 18, 1925).—From an analysis of 8,239 Stoll egg-counts made in Ceylon, previously treated persons were found to have a considerably lower infection intensity than untreated persons, the reduction being greatest in the children's groups. Re-infection with hookworms subsequent to treatment was found to be most rapid in the first three years after treatment. Between the third and seventh years after treatment intensity rates remained at a level, with variations of less than 12 worms, and then began to rise. The percentages of persons found infected showed an initial sharp rise and then a small steady increase. The average length of life of the adult hookworm was suggested to be between three and five years. The importance of sanitation was upheld, but it was argued that the impossibility of immediately introducing adequate sanitation was no bar to the eventual accomplishment of hookworm control.

Intensity of Hookworm Infestation in Alabama. Its Relation to Residence, Occupation, Age, Sex and Race (W. G. Smillie and D. L. Augustine, *Journal of the American Medical Association*, Dec. 19, 1925).—True hookworm disease as a real economic menace to the welfare of the people in Alabama is limited to the rural white children of school age. Hookworm infestation is widely distributed among all ages, social, economic and racial groups. The persons with light infestations are not to be ignored, for they are hookworm carriers and are potential sources of danger to the community. They are not cases of hookworm disease, however, and should be considered as such. If these facts are true for Alabama, they are probably also true for the other coastal plain, Southern States having a similar type and distribution of population, and similar climatological and geological conditions. Sanitation and education must be the chief modes of control of the carrier. Long experience by many workers has clearly shown that treatment alone is of little avail in the control of incidence of infestation in an area favourable to development of hookworm larvæ.

Factors that Influence the Rate of Increase of Hookworm Infection (W. A. Sawyer, *The American Journal of Hygiene*, November, 1925).—The conclusions of this study are as follows: For every infected community, at a given time, there is a level of equilibrium of intensity of hookworm infection, which may be defined as the average number of worms per person which would be present if the existing conditions had been constant over a long preceding period of years. If the environmental conditions affecting hookworms are fairly constant and unaffected by control operations, this level of equilibrium would be approximately equal to the aver-

age number of hookworms per person, as ascertained by an adequate series of egg-counts or worm-counts.

When the intensity of infection is at equilibrium, two factors, or sets of forces, are balancing each other. One is the effect of density of hookworm "population" on the rate of reproduction, as the terms are used in this discussion; in general, the rate of reproduction rises with a decrease in the density of population. The other factor is the effect of the complex combination of environmental conditions which affect hookworms and their ova and larvæ.

Mortality curves for the two species of hookworms infesting man would be very useful. A method is suggested for ascertaining them. Until the essential data have been collected, the principles advanced in this article and the assumed curves, based on those of *Drosophila*, may be used in planning hookworm control operations, but the curves will require much correction with growing experience and should be replaced as soon as possible by data based on observations on hookworms.

Bismuth in the Treatment of Syphilis (Surgeon Commander R. J. G. Parnell, *Journal of State Medicine*, January, 1926).—After two years' experience of metallic bismuth in the treatment of syphilis the author has come to the following conclusions, but he does not offer them as the last word upon the subject.

Bismuth must not be considered a substitute for the salvarsan-type drugs. It is inferior to Ehrlich's preparations, but superior in every respect to mercury. Compared with mercury it is less toxic, exercises a more powerful influence on manifest lesions, and appears to affect the serum Wassermann to a greater extent. It is very valuable in cases intolerant of, and unsuitable for, arsenic therapy. In certain cases where prodromal treatment is desirable, before establishing arsenical therapy, bismuth is safe and efficacious. In the school which favours adjuvant treatment, bismuth should replace, and to a large extent has replaced, the use of mercury.

Bismuth would appear to have especially beneficial effects upon cases of glossitis and chronic leukoplakia of the mouth. It is tolerated well by cerebro-spinal cases, and evidence is accumulating that it apparently influences favourably the meningeal involvement. It can be given safely to cases of arsenical jaundice. In old cases of syphilis (latent cases) it appears to be the equal of salvarsan and neo-salvarsan in its influence upon the Wassermann reaction, but there is not sufficient evidence to justify any statements to the effect that the negative reactions obtained are permanent ones.

Contribution to the Question of Dysentery Carriers in the Philippine Islands (Ana Vazquez-Colet, *The Philippine Journal of Science*, October, 1925).—The author has demonstrated the existence of healthy carriers of *Bacillus dysenteriæ* in the Philippine Islands by the isolation of cultures which, according to standard methods of identification, proved to be *B. dysenteriæ*. In 3,328 examinations 14 carriers were found, of whom seven harboured the Shiga type, six the Flexner type, and one both Flexner and Shiga types successively. Agglutination tests were performed with the carriers' sera and with the corresponding cultures isolated from the carriers, as well as with stock cultures of the Shiga and Flexner types. Usually the serum of the carrier agglutinated its own strain to a lesser degree than the stock cultures, and at times a considerable inhibition zone was noticed with the carriers' serum and its own strain. All of the cultures belonging to the Shiga type, isolated from the carriers, were pathogenic for white mice, and some of them were strongly toxic to rabbits. The cultures belonging to the Flexner type, isolated from the carriers, were found to be of low virulence.

Ætiology of Granuloma Inguinale with a Clinical Report of Three Cases (L. H. Cornwall and S. M. Peck, *Archives of Dermatology and Syphilis*, Nov. 1925).—In all the three cases studied organisms believed to be identical were isolated. Lesions resembling clinically and pathologically those observed in human cases were reproduced in rabbits by intracutaneous inoculation, and an organism believed to be identical with the one cultured from human lesions was obtained in cultures from rabbit lesions. Lesions were produced by reinoculation from rabbit to rabbit, and an organism was recovered from the second rabbit apparently identical with that isolated from human cases. The organism isolated has a characteristic morphology in young cultures on Sabouraud's medium. This morphology disappears in old cultures and is not reproduced in subcultures. It is the authors' belief that the organism described is the causative factor of granuloma inguinale.

Miliary Lichen Planus. Report of Case (E. R. Maloney, *Archives of Dermatology and Syphilology*, November, 1925).—It would appear from the study of the case described that there are cases of lichen planus of a rather unusual type for which, because of the character of the papules, the name miliary lichen planus as applied by Pels would be appropriate. Crocker uses the term "acute miliary lichen planus" in describing a very different type of the disease—a severe acute form which may be primary or which may occur on an existing eruption, and which is attended with serious constitutional symptoms and in rare cases even terminates in death. The papules in these cases, however, seem to be typical lichen planus papules, and although small, are generally arranged in a more or less typical way. They are bright red, and itching is a prominent and often severe symptom.

A Field Study of Mountain Malaria in Brazil (Nelson C. Davies, *American Journal of Hygiene*, January, 1926).—An examination was made of 201 persons living in railroad construction camps in the mountains near Andra dos Reis, State of Rio de Janeiro, Brazil. Thirty-nine infected individuals were found, of whom ten were gametocyte carriers. The predominant local anopheline mosquito was *A. bellator*, known in Brazil as *Anopheles* (or *Myzomyia*) *lutzi*. In a series of over 400 stomach dissections of this species one cyst was found, in a mosquito captured while biting a *vivax* gametocyte carrier. More than 150 of the mosquitoes examined were known to have fed on the blood of gametocyte carriers. This mosquito, therefore, shows an extremely low grade of susceptibility to infection with plasmodia. The presence in the locality of the following additional anopheline mosquitoes was verified: *A. eiseni* (*A. tibiamaculatus*), *A.* (*Myzorhynchella*) *lutzi*, and *A.* (*Cellia*) *argyrotarsis*. It is suggested that the last-named species is probably responsible for a large part of whatever new infections occur in the region. Much fever is attributable to relapses.

Epidemic Disease in West Africa. The Menace of the Future (N. A. Dyce Sharp *Trans. Royal Society of Tropical Medicine and Hygiene*, October 15, 1925).—It would appear that louse-borne relapsing fever was introduced into West Africa in 1920 with the return of the Senegalese troops from the European war area. Drs. Kerrest, Gambier and Bouron reported that relapsing fever first occurred in epidemic form in 1921, in the French Sudan, at Mati on the Niger where the troops were assembled prior to disbandment. The mortality at that time was between 12 and 17 per cent. It was by this route that the disease entered West Africa, where it is a scourge to the native. The initial outbreak of relapsing fever in B.W.A. was on the Gold Coast in July, 1922, among the Zabermawa colony in Accra. These people are sometimes known as Malakala, a term applied to travelling beggars, and are noted for their untidy appearance, uncleanly habits, and notorious lousiness. They come to Nigeria to do odd jobs during the dry season, returning to their country for the rains. The Zabermawa kola traders were responsible, it is believed, for the introduction of plague into Nigeria from the Gold Coast in July, 1924. As introducers of two new deadly diseases into B.W.A. these people are a great danger to the country, and it is feared that before long other diseases, such as typhus, cholera, &c., will make their appearance unless adequate precautions against invasion are taken in time. The types of relapsing fever prominent in Nigeria resemble the Indian forms. The organism is not unlike *Spirochæta carteri*. The disease in West Africa resembles malaria and influenza in its protean character, and readily yields to appropriate treatment.

A Report of Typical and Atypical Bacillus dysenteriæ Shiga, with Special Reference to Agglutination Reactions (G. R. Lacy, *The Philippine Journal of Science*, November, 1925).—Forty-five strains of bacilli similar to and identical with *Bacillus dysenteriæ* Shiga have been studied in this series. Serologically, twenty-seven strains formed one group which corresponded to typical *B. dysenteriæ* Shiga, and nine others formed a heterologous group agglutinated only by their homologous immune sera. The members of the large agglutinable group and the inagglutinable group were indol-positive with two exceptions. The two smaller groups corresponded culturally to the Schmidtz bacillus, while the larger group corresponded to the Shiga-Kruse group of true *Bacillus dysenteriæ*. The members of the three different groups were pathogenic for rabbits. Polyvalent antidysenteric serum afforded protection against experimental inoculation with cultures of all three groups.

Abstract.

VIBRIOS IN HUMAN EXCREMENT.[1]

By K. Vallipuram,
and
W. R. de Silva.

Non-pathogenic vibrios are very rarely seen in smears of stool, and they are seldom isolated during the usual cultural examinations for the presence of *Vibrio choleræ* in suspected material.

During an outbreak of cholera in the North Central and Eastern Provinces of Ceylon rectal swabs of specimens of stools were examined from 1,180 contacts for the detection of temporary carriers of cholera. Vibrios were isolated from 11 of these persons, and nine of these organisms by cultural and agglutination tests were proved to be *V. choleræ*. The other two vibrios did not agglutinate with anticholera serum even in very low dilutions. They were morphologically indistinguishable from cholera vibrios and each organism had a single terminal flagellum.

Vibrio No. 1 gave the same cultural reactions as *V. choleræ;* but it reduced nitrates to nitrites to a smaller degree than *V. choleræ*. It produced acid in lactose, saccharose, mannite, maltose and glucose, and liquefied blood-serum and slightly clotted milk which later became peptonized.

Vibrio No. 2 did not produce acid in glucose nor reduce nitrates nor form indole in peptone water nor liquefy serum.

The man who harboured Vibrio No. 1 had not suffered from gastro-intestinal derangement. The organism was isolated on four repeated occasions and was present in the man's stool three weeks after the first occasion on which it was isolated. This

[1] Abstracted from the *Ceylon Journal of Science*, vol. i, part 3, November 18, 1925.

contrasts for persistence with *V. choleræ*, which disappeared within ten days from the stools of all the nine contacts who had harboured it.

Serum which agglutinated this organism was easily prepared; after two injections of a peptone water culture into a rabbit, the rabbit's serum agglutinated the organism in a dilution of 1 in 1,000, but did not agglutinate *V. choleræ*. Vibrio No. 2 was partially agglutinated in dilutions up to 1 in 200 by this anti-serum; but it differs so markedly in cultures that it is obviously a different organism.

Vibrio No. 1 differs from the Finkler Prior Vibrio by producing indole and from *V. metchnikovi* by the fact that it is not pathogenic to guinea-pigs and fowls.

Serum which agglutinated Vibrio No. 2 was also prepared, and it agglutinated the organism in dilutions of 1 in 1,000, but did not agglutinate *V. choleræ* nor Vibrio No. 1.

We can find no description of vibrios which agree on all cultural tests with the vibrios. Bergey, in his latest manual, describes 11 species, but not one of these is similar to either of the vibrios here described.

Dr. Castellani has described an organism which he named *Spirillum zeylanicum* in 1910, *Vibrio zeylanicus* in 1913, *Bacillus zeylanicus* in 1913, *Vibriothrix zeylanica* in 1917, and *Streptobacillus zeylanicus* in 1918.

We have isolated this organism on one occasion from fæcal matter. It is an exceedingly polymorphic bacillus, and although occasionally curved forms are seen, it is obviously not a vibrio, and could not be mistaken for *V. choleræ* or any other well-marked vibrio.

Current Literature.

Bulletin de la Société de Pathologie Exotique. October 14, 1925.

Investigations on Plague in Cambodia in 1924, carried out at the Laboratory of Pnom-Penh (E. Le Cousse).—The results of these investigations show that plague exists to a large extent at Pnom-Penh. Of 1,065 organs examined 103 showed positive diagnosis of the disease besides other doubtful cases. Nine cases were infants up to 2 years of age; 7 cases were found in children from 2 to 5 years, and 88 were over 5 years, the greater number in adolescents and adults; very rarely was the disease found in old people. In 1924 the majority of cases were of the bubonic form. There was no case of pulmonary or of dysenteriform plague. Investigations for intestinal amœbiasis gave 224 positive cases.

Two New Cases of Cutaneous Leishmaniasis observed in Natives of Morocco in the Region of Fez (P. T. Flye Sainte-Marie and A. Mansouri).—The first case of cutaneous leishmaniasis was reported in this bulletin in 1924 by Dekester and Melnotte. Two further cases have been obser in men aged respectively 35 and 45 years. T disease is apparently very rare in North Moroc as only sporadic cases are seen, but prolon investigations would no doubt bring to light imp ant centres where it is endemic or establish presence of other sporadic cases.

American Leishmaniasis of the Frontal Sin Favourable Treatment by Iodide of Quinine a Bismuth (E. Escomel).—The author has obser a very curious case of American leishmaniasis in woman of 40 years of age. She had lived at As lero, south of Peru, for fifteen years. Fifteen da after her arrival, when going to bathe in the riv she was bitten by an organism which she did n see. She scratched, but gave no importance to t bite. It was later transformed into a papule, a then into an ulcer which she could not cure, no withstanding the many treatments she tried. year after she left for Arequipa, and after anoth year the ulcer was apparently cured. Six mont ago the infection broke out again after having be latent for thirteen years, although she had be living in a cool town. The region of the nose an forehead was most painful. The nasal extremit was hypertrophied and ulcerated, and abundan leishmania were found in the thick yellow liqui from the crusts. The interior of the nose was als badly ulcerated. The region of the frontal sinu was swollen and painful. American leishmaniasi clinically resembles syphilis. Iodobismuthate o quinine in conjunction with intravenous injection of emetin caused rapid amelioration.

Epidemiological Study of a Plague Centre in South-East Russia (O. Aristarkhova).—In June, 1924, being notified of the death of three Kal moukes, the author went to investigate at the place indicated. As is the custom in these parts, the inhabitants had fled to the Steppes after having buried their dead. Autopsy of the deceased subjects proved that they had died of broncho-pneumonial plague. On questioning the Kalmoukes, who were found 12 km. away, it was found that the father, aged 35 years, and his younger brother had died of the disease between four to five days; the wife also got ill and died at the end of two days. Among the 35 people who had fled, two women and a girl of 4 years were ill; the women died between one and two days and the girl recovered. During the following days several others got ill and died. Yersin bacilli were found in all the sputums and characteristic lesions of broncho-pneumonial plague were found at autopsy. The savage rodents of the place were examined; the spermophiles were found to be carriers of plague bacillus. Some days afterwards another case was reported, which proved to be bubonic plague. Contamination had apparently been brought about by lice on cats, who had eaten savage rodents but had remained in demnified.

Note on a Herpetic Virus of Moroccan Origin (T. Remlinger).—The patient was a native of

Morocco, 18 years of age, and worked in the laboratory of the Pasteur Institute. On July 11 he suddenly developed a severe attack of fever. He was sent home, but came to the Institute the next day saying he felt quite well, and he resumed his work. The following day he was greatly distressed, his lips being very much swollen and almost entirely covered with large blisters. The eruption spread inside the mouth and later ulcerated badly, rendering the partaking of food impossible. There was no fever. In three days the patient was cured. A quarter of a cubic centimetre of the liquid from the blisters was inoculated into the brain of a rabbit on July 13. Nothing happened until the fourth day after inoculation, when the animal appeared ill, had abundant saliva, roamed round the cage, and looked as though he were trying to play the drum. On the sixth day he hardly moved. A thick, abundant, muco-fribinous exudate came from the anus; there was a violent epileptic crisis, and the animal died. Autopsy was completely negative. Four other rabbits inoculated by trepanation with the same substance died of typical herpetic encephalitis between four to six days after inoculation. The virus acquires a fixed pathogenicity when inoculated successively into rabbits and regularly causes death the third day. The experiments prove that the virus from Morocco in no way differs from that in Europe.

Tokelau (Tinea imbricata) in the Chinese Province of Honan (G. Villain).—Tokelau has been known to exist in the southern or tropical part of China for some years, but this is the first case described in the northern regions. The patient was 37 years of age, a native of Shantung, but had lived at Honan for a long time. He was a carpenter by trade. Nothing notable in his past history or in that of his antecedents. He had been infected for about three years, but could not give any precise details as to the beginning of the disease or its evolution. When seen by the author the patient presented a dermatosis on the gluteal region, the thighs, and inguinal region. On the arms there were a few concentric lesions, though nothing was visible on the other parts of the body. A fungus isolated from this case showed all the characteristics of *Tinea imbricata* described by Castellani, and differed notably from the *Tinea sabouraudi* of Sabouraud.

Three Cases of Enteritis due to Trichomonas cured by Stovarsol (Mme. A. Panayotatou).—During the years 1915-21, 709 specimens of stool have been examined at the Greek Hospital at Alexandria. 428 were positive for amœbæ, 93 were positive for *Trichomonas*. The percentage of infected cases was greatest in 1920, i.e., 23·8. Although the number of cases of dysentery and enteritis due to *Trichomonas* is not very high, the parasite must be considered as the cause of serious intestinal troubles. This has also been noted by Brumpt and Marchoux. The author describes three cases of intestinal infection in which no other agents but trichomonas were found, and which yielded to stovarsol after all other medicaments had failed. Besides being very effective in treatment, stovarsol is administered without any difficulty by the mouth, and is less expensive than treatment by injection.

Filariasis in a European in New Caledonia (R. Herrmann and J. Genevray).—Animal filaria are very numerous in New Caledonia; human filaria have been observed by several authorities, but the disease is not very frequent, especially among Europeans. No case has been reported since 1911. The present case was the first detected during the authors' three years investigations, and was caused by *Filaria bancrofti*. The patient, aged 13 years, had never left the colony; she was anæmic and presented pronounced hemato-chyluria. The first examination of the urine, October 30, 1923, showed 5 to 9 filaria embryos per field. November 6 about 6 microfilaria were found in each drop of blood examined. Injections of sulfarsenol cured the patient, and all further examinations for filaria were negative until December, 1924, when one microfilaria was found in the blood, but the patient considered herself cured and refused treatment and further examinations.

Intestinal Bilharziasis in the Form of Abdominal Tuberculosis (H. Fabre).—Guadeloupe is an important centre of intestinal bilharziasis, which had hitherto been ignored. It was only by microscopical examinations that the disease was detected; in one year about fifty cases have been observed, three of which presented interesting symptomatological characteristics. The three cases, aged 5, 13 and 22 years respectively, were suffering from evening fever and chronic constipation, no other visible symptoms, and were thought to be suffering from intestinal or pulmonary tuberculosis. Examination of the stools showed the presence of numerous eggs of *Schistosomum mansoni*. Treatment by intravenous injections of emetin was effective.

Anopheles in the Higher Regions of Corsica. Presence of A. bifurcatus and of A. plumbeus in the North and South of the Island (A. Catanei).—During the summer of 1925 the author made investigations in the high northern regions of Corsica and along the East and West Coast. Numerous sites of anopheline larvæ were found almost everywhere. The parasite lives in the larval state in all stagnant and slow flowing waters. Except at Corte, where malaria has been known to exist for some time, the other regions were believed to be exempt from the disease.

THE INDIAN MEDICAL GAZETTE.
January, 1926.

Cholera in the Punjab. An Epidemiological Note (C. A. Gill).—Punjab contains no permanent foci of cholera, and in almost every instance outbreaks of the disease in this province are directly or indirectly traceable to importation of infection

from outside the province. In the majority of cases the disease appears to be introduced by Hindu pilgrims from Bengal, Bihar and Orissa, the endemic home of cholera. There was a mild epidemic in the summer of 1924 in Punjab, with the result that 4,118 cases and 3,551 deaths occurred, as compared with 25 cases and 11 deaths the previous year. The course of the malady was normal and completely disappeared in November, and from this time up to the beginning of April, 1925, the province was free from cholera. In April there was a small outbreak amongst Mohammedans. Subsequent investigation showed that infection was conveyed to an adjacent village in the Salt Range, where a large fair, attended by some 50,000 people, was being held. On April 12 there was an explosive outbreak of cholera involving several hundred pilgrims who were dispersing to their homes. The early cases of cholera are rarely typical, and there is a strong tendency to hide the existence of the disease until the completion of the religious ceremonies that usually culminate in a ceremonial ablution and drinking of the sacred waters on the last day of the fair. The manner in which the first town became infected could not be determined. In about ten days 800 cases and 320 deaths occurred solely among the pilgrims in eleven different parts of the province. The total number of cases and deaths from cholera from April 1 to August 8, 1925 was 5,841 and 2,129 respectively. This is the worst outbreak that has occurred during the past thirty years. The most interesting epidemiological features in this outbreak are, firstly, the appearance of cholera in epidemic form in April instead of the normal season, July-September. Secondly, the spread of infection from the north instead of from the endemic area in the United Provinces. Thirdly, the epidemic involved Mohammedans in its early stage instead of Hindus, which is generally the case.

On a Species of Trichomonas Prevalent in Calcutta (B. Mohan das Gupta).—The results of these investigations are that the prevalent type of human intestinal trichomonad in Calcutta is *Pentatrichomonas ardin delteilli* (Derrieu and Raynaud), 1914. *Pentatrichomonas* is a parasite with a tropical distribution, whereas *Trichomonas, sensu stricto*, is a parasite rather of temperate zones. As to its pathogenicity or non-pathogenicity to man nothing definite can yet be said. It can be readily cultivated in Row's hæmoglobin-saline medium at 37° C.; at 22° C. and lower temperatures cultures die within twenty-four hours. A strain has been kept alive in Row's medium by sub-passage every third day, for sixty-three days. When kittens are fed with rich cultures of this parasite, viable flagellates pass unchanged through the stomach and intestine and settle in the cæcum, where they appear to be able to establish a localized infection. The test for the viability of these forms was by culture. This appears to confirm Kofoid's suggestion that *Pentatrichomonas* infection in man may be acquired, not by swallowing cysts, since the cumulative work of many investigators has failed to discover such cysts, but by ingestion of the flagellate in its motile and vegetative form.

An Account of an Outbreak of Cholera at Goalundo Ghat (W. J. Marshall).—During the period September 19 and October 8, 1925, 24 cases of cholera were admitted to Goalunda Ghat Hospital, all of whom recovered under treatment with atropine, hypertonic saline and alkalies.

The Occurrence of Urticaria in the Treatment of Malaria by Quinine (T. A. Hughes).—Two cases of malaria are described; in one quinine produced a marked urticarial eruption all over the body, while in the other it aggravated a generalized urticaria already existing as a result of the malarial attack. In the first case the rash was not alleviated or prevented by bromides or calcium lactate, but hypodermic injections of adrenalin hydrochloride about five minutes after each dose of quinine had a very good effect on the urticaria. In the second case, adrenalin administered as in the first case did not benefit the skin condition, but prevented its aggravation by quinine. On the other hand, calcium lactate in 30 gr. doses seemed to bring relief, but bromides were without effect. The eruption disappeared on the fourth day after admission and the patient left hospital.

A Case of Kala-azar in the Simla Hills (B. J. Bouche).—The case described is one which is often mistaken for chronic malaria. The patient, an Anglo-Indian girl, arrived at Jutogh, Simla Hills, from Sanawar with a statement from a medical officer that she was suffering from anæmia, the result of chronic malaria. She was ill-nourished and emaciated, enlarged spleen, temperature 99·4° F., liver slightly enlarged downwards. Blood negative for malaria. Had fever eight years ago which was suspected to be kala-azar. Has had fever of low, irregular type, and was repeatedly treated for malaria with no benefit. Frequently in hospital and had been in association with a case of kala-azar there, she was also in contact with her aunt, who was suffering from the disease. Injections of quinine bihydrochloride. Urine showed marked chyluria, and a large number of microfilariæ were present. The quinine was increased to 10 gr. t.d.s. and a mixture of tinct. ferri perchlor. and glycerine was added as an antifilarial measure. The patient's appetite was retained throughout the fever. The finger blood was examined for the fifth time for malaria without success. Leishman-Donovan bodies were seen in three large mononuclear leucocytes. On the fifth day of treatment the chyluria had disappeared, but the filariæ still persisted in the urine. A few days later a severe urticarial eruption broke out immediately after the urea stibamine injection, accompanied with nausea and vomiting, but it only lasted for half an hour. After three months' treatment the patient was completely cured.

Original Communications.

ANKYLOSTOMIASIS: COMPARATIVE EFFICIENCY OF CARBON TETRACHLORIDE, CHENOPODIUM AND THYMOL IN THE TREATMENT OF HOOKWORM INFECTION.

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THIS report deals with the results obtained from three drugs (carbon tetrachloride, chenopodium and thymol) used against hookworm as observed in cases treated in Zamboanga General Hospital. About 95 per cent. of the cases were Filipinos.

Carbon tetrachloride was given as follows: The patient takes no supper or breakfast; at 6 a.m. he is given 1 c.c. of carbon tetrachloride for every 5·5 kg. of body weight. The drug is given in a little water and all alcoholic medicines suspended during the treatment. He usually develops dizziness and occasionally vomits. Should vomiting take place before half an hour has elapsed after taking the drug, another dose is given. The patient should lie down to avoid vomiting. The bowels often begin to move half an hour after taking the drug, and three to seven additional stools follow within 24 hours. The drug was also given in doses of 1 c.c. for every 7 kg. and 10 kg. of body weight, and in combination with saturated solution of magnesium sulphate, 4 c.c. of carbon tetrachloride was the maximum dose for adults, and in the following combinations according to age:

(*a*) 10 drops of carbon tetrachloride and 15 c.c. magnesium sulphate	1 to 5 years
(*b*) 1 c.c. of carbon tetrachloride and 20 c.c. magnesium sulphate	5 to 10 ,,
(*c*) 2 c.c. carbon tetrachloride and 25 c.c. magnesium sulphate	10 to 15 ,,
(*d*) 4 c.c. carbon tetrachloride and 45 c.c. magnesium sulphate	adult

Chenopodium was given as follows: The night before treatment, supper consisted of soft boiled rice. (During the day of the treatment only milk was given.) At 6 a.m. 1·5 c.c. of chenopodium (freshly filled into gelatine capsules) was administered; at 8 a.m. the same dose was given, and at 10 a.m. 40 c.c. of saturated solution of magnesium sulphate was administered. The dose for children was computed according to the standard rule.

Thymol was administered as follows: No food of any kind was taken in the morning of the treatment. At 6 a.m. 1·3 grm. in one capsule and at 8 a.m. another capsule of 1·3 grm. was administered. At 10 a.m. 45 c.c. of saturated solution of magnesium sulphate. This applies to the dose for adults.

After all the above described treatments, all the bowel movements were collected for 24 hours in the case of carbon tetrachloride, and 48 hours in the cases treated either with chenopodium or with thymol. Practically no hookworms were recovered in the second 24 hours' stools after carbon tetrachloride, while a certain percentage was found in the chenopodium and the thymol cases (Table IV). The stools were screened very carefully through an 80-mesh to the square inch screen. Microscopic controls were performed at least 48 hours after treatment. If re-examination resulted positive, subsequent treatments were given at intervals of 4 to 5 days. The direct smear examinations of the stools were always supplemented with concentration and cultural methods.

Table I shows the number of cases treated with different doses of carbon tetrachloride, with chenopodium, and with thymol, the number of treatments, number and percentage of cures, and number and percentage of failures. It will be seen that all the way through carbon tetrachloride is superior to the other drugs. Carbon tetrachloride in doses of 1 c.c. per 5·5 kg., 7 kg., and 10 kg. body weight, and mixed with magnesium sulphate cured 55, 52, 34 and 53 per cent. respectively; chenopodium, 40 per cent.; thymol, 26·3 per cent., with the first treatments, and 73, 75, 61, 67, 33 and 20 per cent. respectively with the second treatments. The only objection to carbon tetrachloride noticed was that it produces dizziness, vomiting, and a varying degree of debilitation. These symptoms, however, are practically nil when the drug is given in doses of 1 c.c. to 10 kg. body weight and in combination with magnesium sulphate as described. The carbon tetrachloride must be repurified C.P. to be safe. Ill effects were not noted either with chenopodium or with thymol.

TABLE I.—THE CURATIVE EFFECT OF CARBON TETRACHLORIDE, CHENOPODIUM AND THYMOL.

Drugs used and dose.	CCl_4 1 c.c. for every 5·5 kg. body-weight	CCl_4 1 c.c. for 7 kg. body-weight	CCl_4 1 c.c. 10 kg. body-weight	CCl_4 and Mag. Sulp.	Chenopodium 3·0 c.c.	Thymo 2·6 grm.
Number 1st treatment	200	44	38	43	57	38
Number negative	111	23	13	23	23	10
Percentage negative	55	52	34	53·5	40	26·3
Number positive	89	21	25	20	34	28
Percentage positive	45	48	66	46·5	60	73·7
Number 2nd treatment	45	12	18	15	21	15
Number negative	33	9	11	10	7	3
Percentage negative	73	75	61	67	33	20
Number positive	12	3	7	5	14	12
Percentage positive	27	25	39	33	67	80
Number 3rd treatment	8	—	—	—	8	10
Number negative	4	—	—	—	7	5
Percentage negative	50	—	—	—	87	50
Number positive	4	—	—	—	1	5
Percentage positive	50	—	—	—	13	50
Number 4th treatment	—	—	—	—	1	4
Number negative	—	—	—	—	0	0
Percentage negative	—	—	—	—	0	0
Number positive	—	—	—	—	1	4
Percentage positive	—	—	—	—	100	100

Thymol in small pieces has been found many times in the stools, and in one case two pieces, practically the size and shape of the capsules administered, were found during screening. The thymol was well powdered and freshly put into capsules. It seems, therefore, that, due to some action of the gastric or intestinal contents, the drug failed to dissolve, and that it even fused.

Table II shows the number of cases given two treatments, the drugs used, the total number of worms recovered with two treatments, the number recovered with the first treatment, the number recovered with the second treatment, and the percentage of worms recovered by the first treatment. A higher percentage of worms was recovered by the first treatment with carbon tetrachloride than after treatment with the other drugs. Carbon tetrachloride 1 c.c. for 5·5 kg., 7 kg., and 10 kg. of body weight, and mixed with magnesium sulphate, chenopodium, and thymol removed 97, 96, 91, 93, 89·5 and 74·1 per cent. respectively by the first treatment.

TABLE II.—PERCENTAGE OF WORMS REMOVED BY THE FIRST TREATMENT.

Drugs and dosage.	CCl_4 1 c.c. per 5·5 kg. body-weight.	CCl_4 1 c.c. per 7 kg. body-weight	CCl_4 1 c.c. per 10 kg. body-weight	CCl_4 and magnesium sulphate	Chenopodium 3 c.c.	Thymol 2·6 grm.
Number given two treatments	33	10	17	10	23	20
Total removed, two treatments	1421	335	291	248	1688	666
Total removed by first treatment	1381	324	266	231	1518	494
Percentage	97·0	96·5	91·0	93·0	89·5	74·1

Table III shows the vulnerability of species and sex by the use of the different drugs, computed on worm classifications on cases given two treatments. Carbon tetrachloride 1 c.c. to 7 kg. body weight removed 95·2 per cent. of ankylostomes and 98·8 per cent. of necators, by the first treatment, chenopodium 3 c.c. removed 72 per cent. of ankylostomes and 91 per cent. of necators. Thymol removed 64·3 per cent. of ankylostomes and 74·8 per cent. of necators. To all the drugs used the necators are more susceptible than ankylostomes and the males more than females.

TABLE III.—THE VULNERABILITY OF SPECIES AND SEX TO THE DRUGS USED.

Drug used and dose	Number cases		First treatment Ankylostome Male	First treatment Ankylostome Female	First treatment Necator Male	First treatment Necator Female	Second treatment Ankylostome Male	Second treatment Ankylostome Female	Second treatment Necator Male	Second treatment Necator Female	Total
CCl_4 1 c.c. per 7 kg. body weight	4	Number worms by sex	187	183	98	132	8	11	1	2	6
		Per cent. by sex	96	94·4	99	98·5	4	5·6	1	1·5	—
		Number worms by species	370		230		19		3		—
		Percentage by species	95·2		98·8		4·8		1·2		—
Chenopodium 3 c.c.	10	Number worms by sex	58	49	401	380	15	26	31	47	1,0
		Percentage by sex	79·5	65·4	92·9	89	20·5	34·6	7·1	11	—
		Number worms by species	107		781		41		78		—
		Percentage by sex	72		91		28		9		—
Thymol 2·3 grm.	20	Number worms by sex	17	10	163	304	7	8	47	110	6
		Percentage by sex	70·8	55·5	77·6	73·4	29·2	44·5	22·4	26·6	—
		Number worms by species	27		467		15		157		—
		Percentage by sex	64·3		74·8		35·7		25·2		—

Table IV shows the discharge of worms the first 24 hours and the second 24 hours after treatment. Worms were not recovered in the third 24-hour stools; with carbon tetrachloride 0·3 were recovered in the second 24 hours, while with chenopodium and thymol 8·5 and 4 per cent. respectively were recovered. This seems to show that carbon tetrachloride is rapid in its effect in that practically no worm was passed in the second 24 hours after treatment.

TABLE IV.—THE DISCHARGE OF WORMS DURING THE FIRST 24 HOURS AND DURING THE SECOND 24 HOURS AFTER TREATMENT (FIRST TREATMENT).

Drug	Number of cases	Total worms	First 24 hours	Second 24 hours	Percentage worms in second
CCl_4 1 c.c. for 7 kg. body-weight	8	355	352	1	0
Chenopodium 3 c.c.	13	717	656	61	8
Thymol 2·6 grm.	20	434	417	17	4

SUMMARY.

(1) Carbon tetrachloride 1 c.c. for every 5·5 kg of weight was given to 200 cases once, curing 9 per cent.; to 45 cases twice, curing 73 per cent to 8 three times, curing 50 per cent. Carbon tetrachloride 1 c.c. for every 7 kg. body weight was given to 44 cases once, curing 52 per cent.; to 1 cases twice, curing 75 per cent. Carbon tetrachloride 1 c.c. for every 10 kg. body weight was given to 38 cases once, curing 34 per cent.; to 1 cases twice, curing 61 per cent. Carbon tetrachloride 4 c.c. as maximum adult dose mixed with saturated solution of magnesium sulphate was given to 43 cases once, curing 53·5 per cent.; to 1 cases twice, curing 67 per cent.

(2) Chenopodium in the dose of 3 c.c. was given to 57 cases once, curing 40 per cent.; to 21 cases twice, curing 33 per cent.; and to 8 cases three times, curing 87 per cent.

(3) Thymol, 2·6 gm., was given to 38 cases once, curing 26·3 per cent.; to 15 cases twice, curing 20 per cent.; to 10 cases three times, curing 50 per cent.; to 4 cases four times, curing none.

(4) Carbon tetrachloride 1 c.c. for every 5·5 kg body weight removed by the first treatment 97 per cent. of worms (from those given two treatments) 1 c.c. for every 7 kg., 96·5 per cent.; 1 c.c. for every 10 kg., 91 per cent.; carbon tetrachloride and magnesium sulphate, 93 per cent.; chenopodium 3 c.c. 89·5 per cent., and thymol 2·6 kg. 74·1 per cent.

(5) Carbon tetrachloride 1 c.c. for every 7 kg. body weight removed 95·2 per cent. of ankylostomes and 98·8 per cent. of necators with the first treatment; chenopodium, 72 per cent. of ankylostomes and 91 per cent. of necators; thymol, 64·3 per cent. of ankylostomes and 74·8 per cent. of necators.

(6) Carbon tetrachloride 1 c.c. for every 7 kg. body weight removed 96 per cent. of male ankylostomes and 99 per cent. of male necators; chenopodium 79·5 per cent. of male of ankylostomes, 92·9 per cent. of male necators; thymol, 70·8 per cent. of male ankylostomes, 77·6 per cent. of male necators. Carbon tetrachloride removed 94·4 per cent. of female ankylostomes and 98·5 per cent. female necators; chenopodium 65·4 per cent. of female ankylostomes, 89 per cent. of female necators; thymol, 55·5 per cent. of female ankylostomes and 73·4 per cent. of female necators.

(7) Apparently carbon tetrachloride is more rapid in its action than the other drugs.

SUBACUTE INGUINAL PORADENITIS, OR CLIMATIC BUBO.

By E. P. DE BELLARD.

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THE present study is based on 22 cases of poradenitis that I have treated at the Beacon-Sun Hospital in the course of the past four years. All, except one, occurred in Americans who had resided in Venezuela for a period that varied between two weeks and two years.

This disease has been known for many years under two different names, and it is only very recently that the majority of authors have become convinced that the two are the same identical pathologic process, in the tropics as climatic or tropical bubo, and in Europe under a variety of denominations: strumous bubo, subacute simple adenitis with intraganglionar purulent foci, idiopathic adenitis, subacute inguinal lymphogranulomatosis, adenogenous ulcer, and fourth venereal disease, this confusion in nomenclature being due to differing opinions regarding its ætiology. To Professor Favre, of Lyon, and his pupil, Phylactos, is due the credit of having first called attention to the identity of the tropical and the European diseases.

HISTORY.

Bodnar [1] and Ruber [2] in 1879 were pioneers in drawing a distinction between the bubo they observed in the tropics and the group of common venereal, tubercular, and simple adenitis, and believed it to be a manifestation of malaria. The publication of their observations was followed by those of Segard [3], Guerin [4], Cantlie [5], Lesueur-Florent [6], and Blanc [7]; Cobb and Simpson [8] observed similar cases in India, and believed them to be cases of *pestis minor*, while Ruge [9] treated a small epidemic of the disease on board German war vessels anchored off Zanzibar. Once attention was called to the new malady it was soon reported from nearly all tropical countries. On the other hand, in Europe it was first reported by Chassaignac [10], and later by Velpeau [11], who pointed out the difference between the pathologic findings in the different forms of adenitis, but it was Nélaton [12], and after him his pupil, L'Hardy [13], who first gave a complete description of the disease in Europe, separated it from the group of tubercular adenitis which it so closely resembles at times, called attention to the difficulty of determining the portal of infection, noticed the suspicious presence in some cases of herpetiform genital lesions, insinuated the possibility of this being a transmissible venereal disease, and proposed the name of *simple subacute adenitis with intraganglionar purulent foci*. These interesting studies were followed by those of Lejars [14], Marion et Gandy [15], Pigeon et Tanton [16], and Brault [17]. In 1913 Durand, Nicolas et Favre [18] demonstrated the prevalence of the malady in France, gave it the name of *subacute inguinal lymphogranulomatosis*, and described the initial herpetiform lesion later called by Bory [19] *lymphogranulomatous chancre*. I believe that the thesis of Phylactos [20] practically dispels all doubts about the identity of the two diseases. Desteéfano and Vaccarezza [21] report twelve cases from Buenos Aires and propose the name of *subacute inguinal poradenitis*, which I have adopted in this article because I consider it less cumbersome than others and fairly well descriptive of the disease. The first published report of the prevalence of tropical bubo in Venezuela was by me in 1922 [22]. Comparatively little is found in the medical literature of the United States concerning poradenitis: however, Smith [24], Treilby [25], Phillips [26], Barlow [27], and a few others have given us interesting accounts of cases.

CLINICAL STUDY.

Subacute inguinal poradenitis is a disease of wide geographic distribution, found in all tropical countries and perhaps in many of those of the temperate zone, possibly unrecognized, masquerading under the guise of tubercular inguinal adenitis. In Venezuela it affects mostly young men of the Caucasian race recently arrived in the tropics, whilst women and children of all races are immune. Its most outstanding clinical sign is the presence in the inguinocrural region of a tumour involving several of the lymphatic glands of these groups, which at operation are found to contain numerous small abscesses scattered throughout the whole gland tissue; it is further characterized by extensive periadenitis, a tendency to sinus formation and chronic suppuration, while only mild general symptoms accompany the imposing local syndrome.

Nicolas and Favre were the first to insist on the

genital origin of the infection, and described the initial lesion or *poradenic microchancre*, which affects a variety of forms; most frequently it assumes the appearance of a small, painless, shallow, non-infiltrated ulcerated herpetiform lesion. However, it is but seldom discovered in the cases of poradenitis, be that due to the insignificance of the lesion itself and the fact that it gives rise to no symptoms, or to its evanescent character. I have discovered a typical poradenic chancre in only two of my cases and in neither was its presence suspected by the patient. Nearly all cases of poradenitis that I have seen were in men who had a long prepuce or phimosis and who kept their genitals very unclean, and under these circumstances it is very easy to overlook a microchancre situated at the balano-preputial fold which is its favourite location. But it is possible that the virus may utilize for its accession some other pre-existing venereal lesion.

The portal of entry would seem to be unquestionably somewhere in the genital zone or its immediate vicinity; the usual location of the original bubo, affecting as it does the supero-internal group of inguinal glands, supports this view. However, in the majority of instances it is impossible to locate definitely the point of inoculation, and the most painstaking search will fail to reveal any lesion whatsoever, the bubo being the first evidence of the disease noticed.

That poradenitis is usually of venereal origin seems most probable; that it is always so is questionable, as I have observed it in a young man who had never had sexual intercourse, and Destéfano and Vaccarezza report a similar instance. In two other of my cases the disease made its appearance several months after the last intercourse, so these could not be considered of venereal origin unless we admit the supposition that the virus may be contracted and then remain latent for long periods of time. Again, the disease behaves most unlike the other true venereal diseases: it does not attack women, and, with rare exceptions, spares natives.

Judging by several seemingly clear-cut observations, it might be deduced that the organism producing poradenitis is harboured in the vagina of filthy women and in the smegma of men of unclean personal habits, a long prepuce greatly favouring their habitat, and that it is implanted in the lymphatic mesh and thence invades the inguino-crural nodes through some abrasion in the genital zone inflicted during coitus or through rubbing or friction in the neighbourhood of the pudenda; the infection would be especially favoured if this region were moist and macerated by heat and sweat such as attends violent exercise, long horseback rides, or driving a truck during the hottest season of the year over rough roads.

In my cases poradenitis always started in the supero-internal group of inguinal lymphatic glands on one side, and affected the left more often than the right (64 per cent.), eventually becoming bilateral in 22 per cent. of the cases. In 88 per cent. the inguinal glands alone were involved, but in 22 per cent. the crural glands were later affected. As a rule only the superficial groups of glands are attacked, as in but two of my series did it extend to the deep ones. On the other hand, involvement of the iliac lymph nodes is almost a constant phenomenon. Even when the disease may be properly called unilateral the glands of the opposite side are frequently found to be slightly enlarged and somewhat sensitive to pressure.

The observation in other gland-groups than the inguino-crural of lesions resembling those of poradenitis are extremely rare and have been reported in only half a dozen instances by Ravaut, Boulard and Rabeau, Nicolas and Favre, and Nélaton.

Pathology.

In the course of poradenectomies I have observed all the stages in the evolution of the disease. The first pathologic evidence refers to a stage of congestion with some hypertrophy; the gland assumes a purplish colour and shows abnormal vascularization, and on section presents a granular appearance, diffuse studding with punctiform hæmorrhages and minute areas of grayish infiltration showing early abscess formation especially towards the centre of the gland, while the cortical area is still more or less free. The capsule appears somewhat thickened, surrounded by a delicate meshwork of fine adhesions. Usually no matter how early the case is operated on, not only the main gland affected, but to a variable degree the neighbouring lymph nodes also show these changes. At a later stage the periglandular adhesions have become very strong and extensive, anchoring the gland firmly to its neighbours and to the surrounding tissues. The gland has increased to several times its normal size, and its surface, as well as the central ganglionar mass, are studded with numerous abscesses ranging in size from microscopic proportions to that of a pea. These abscesses are isolated from one another, separated by a zone of apparently healthy parenchymatous tissue, and contain thick, greenish or yellowish, viscid, odourless pus. When the thickened and tough capsule is stripped off, the surface of the lymph node appears roughly granular and is sometimes found covered with a greenish fibrinoplastic exudate which adheres tenaciously to the gland tissue. In the advanced stage of the fully developed disease the tumour is composed of a large conglomerate of agglutinated glands involving several, sometimes all, the glands of the inguinal and crural groups, firmly adherent and fused into one mass; this is surrounded by an atmosphere of extremely tough adhesions which anchor it immovably to all neighbouring structures including not rarely the spermatic cord above and the sheath of the femoral vessels below. In the meshes of this periadenitis are found purulent and hæmorrhagic foci, separate and distinct from each other in the beginning, but later coalescing to form more important collections. The lymph node itself will be found to contain numerous small abscesses

and a large one located centrally, formed by the coalescence of several contiguous purulent foci, and to be discharging its contents through a minute sinus. In neglected cases several of these larger abscesses may have formed, each discharging pus through its own fistula. The parenchyma surrounding the abscesses is the seat of hæmorrhagic infiltration and becomes very friable. The skin covering the poradenic tumour adheres to the underlying mass, sometimes assuming an œdematous, tense, shiny appearance and a characteristic reddish-violet hue.

Rarely, the poradenic gland presents a special and very different aspect: it feels firm, shows no miliary abscesses detectable with the naked eye, and on section presents a perfectly smooth, homogeneous surface of light pink colour and a velvety feel. This peculiar appearance, already noted by Favre, has been very aptly termed by him " chair de poisson," on account of its close resemblance to fish meat; the excised glands in my case No. xxi presented the typical " chair de poisson " lesions. Histologic sections of these glands show the typical stellate abscesses, but they are all of microscopic size.

The curious periglandular cords first mentioned by Brault, and later observed by Favre, have been encountered in four cases: in one it was evidently an enlarged, indurated lymphatic tract twice as thick as a goose-quill, which joined together three adjacent diseased lymph nodes; in another it was a thick cord found crossing the operative field on a line parallel to Poupart's ligament, and which resembled in size and appearance the spermatic cord; in the other two cases they were strong fibrous cords formed by the periadenitic adhesions.

The material obtained at operation in 14 cases was submitted to our Pathologist, Dr. C. Uribe, for study in our laboratory.[1] Briefly, the lesions characteristic of poradenitis consist of an active vascularization, a diffuse infiltration of the lymphoid and periadenitic tissue with plasma cells, with here and there a giant cell, the formation of numerous abscesses of stellate shape, an occasional gummatous lesion very similar in its morphology to those found in lymphatic tuberculosis, and the constant finding of vascular lesions such as endarteritis obliterans, thrombosis, rupture of blood-vessels and hæmorrhage into the lymphoid tissue of the node and into the periadenitic inflammatory zone. Certain so-called *chromatic bodies*, both extra and intracellular, are constantly found with the macrophages on the inner aspect of the epithelioid wall lining the stellate abscesses as well as among those which are free in the contents of the abscess. Our pathologist thinks that they may possibly bear some ætiologic relationship to the disease, but other observers consider them to be remnants of disintegrated polynuclear cells. These *chromatic bodies* show well after staining with Giemsa, or still better, with a combination of Manson's boracic blue and eosin.

[1] For a full discussion of laboratory findings, experiments and case reports, the reader is referred to a previous monograph (see Bibliography, No. 23).

Ætiology.

Several diseases have been accused by different authors of producing the lesions of poradenitis: syphilis, malaria, plague, tuberculosis, gastro-intestinal infections, &c., but careful clinical and laboratory studies carried out by many competent observers, and which our own experiments and laboratory work have only confirmed, have proven these assumptions erroneous.

The ætiologic cause of poradenitis has not been determined. The possibility that the above described *chromatic bodies* may yet be proved to be protozoal organisms playing a pathogenic rôle in this disease is very doubtful. The pus of the closed buboes has constantly been found to be sterile, and slides made with it and with necrotic gland tissue and stained by diverse methods, as well as all cultures made in the usual and special media, have always failed to show the presence of any suspicious organisms. Inoculation experiments were carried out with the material obtained in most of my cases; white rats, guinea-pigs, rabbits, and two *Cebus* monkeys were utilized, and a fresh emulsion of poradenic gland tissue in normal saline was inoculated into the mucous membrane of the prepuce or vagina, intraperitoneally, subcutaneously or intratesticularly. With the exception of three encouraging instances, all our experiments gave us negative results. First: with material obtained from Case xvi, one rabbit, three white rats, and two guinea-pigs were inoculated; two weeks later one of the guinea-pigs showed a bilateral enlargement of the inguinal lymph nodes. While waiting for further developments the adenitis spontaneously disappeared within a few days. The other animals were unaffected. In the second instance, a *Cebus* monkey was inoculated into the prepuce with material obtained from Case xvii on September 6, 1924. By September 28 a tumour-like mass had developed near the root of the penis, firm to the touch and painless, while the inguinal glands on both sides were enlarged. October 14 the lesion on the penis is unchanged, the lymph nodes have increased in size, and the skin over them remains normal and free from adhesions. The largest was excised for histologic study. October 29: a node in the right groin had markedly increased in volume, becoming painful and firmly adherent to all surrounding tissues; the preputial mass had diminished in size and had become softer. After this date all the glands receded gradually, and by the end of November, three months after the inoculation, were normal again, the monkey's health in the meantime not having apparently suffered to an appreciable degree. Sections of the gland removed showed marked vascularization, infiltration with plasma cells, scattered micro-abscesses of stellate form, and the usual vascular lesions that characterize

human poradenitis, but no chromatic bodies were seen, and polymorphonuclear cells, abundant in the human cases, were rather scarce in the tissue examined.

(3) On August 25, 1925, a guinea-pig and a *Cebus* monkey were inoculated in the prepuce with an emulsion of fresh poradenic material collected at operation. The guinea-pig, kept under observation for three months, has remained perfectly well. The monkey showed no local reaction at the point of inoculation or elsewhere in the prepuce such as was observed in the first monkey experimented with, but on September 7 the inguinal glands on both sides were definitely enlarged. They gradually increased in size, and the mass on the left side became somewhat fixed to the surrounding tissues excepting the skin, which remained free from all adhesions to the underlying tumour. On October 3, four weeks after its appearance and six weeks after inoculation, the mass was removed. No definite inflammatory periadenitis was made out, but many fine, delicate adhesions were found lightly fixing the mass to its bed. The tumour consisted of a single, very much enlarged and deeply congested lymphatic node, which on section showed no visible abscesses, but numerous punctiform hæmorrhagic foci.

The mass in the right groin was not interfered with, but as occurs so frequently in human cases of poradenitis, the main focus once extirpated, the enlarged gland on the opposite side began receding at once and could not be palpated two weeks later.

Microscopic sections of the gland removed showed well marked generalized congestion, abnormal vascularization, and scattered hæmorrhages into the parenchyma, with very few foci of apparently incipient necrosis, but no abscesses and a total absence of both chromatic bodies and leucocytic infiltration. The capsule was definitely thickened, and the connective tissue apparently increased throughout the gland. The vascular lesions were the most prominent, and dominated the picture.

While no claim is advanced to having reproduced poradenitis in the monkey the foregoing experiments are at least encouraging and suggestive.

The able and important assistance and co-operation of Dr. C. Uribe, formerly our Pathologist, in carrying out the necessary experiments and laboratory work for the preparation of this study is here gratefully acknowledged.

Symptomatology.

The appearance of a mass in the groin accompanied by a feeling of tension and discomfort, are the first and often the only signs during several days, and the patient may even be able to follow his occupation, but soon other symptoms supervene, such as persistent anorexia with marked loss of weight, profound lassitude and fever, while the tumour becomes painful on walking, though painless at rest. The fever rises to 38° or 38·5° C., and affects the continuous type with marked morning remissions, or more frequently the intermitten with normal temperature in the morning and a evening rise. Rarely, a high temperature of th continuous type persists for many days, simulatin typhoid fever.

The duration of the fever is variable: it may di appear after three or four days, but more frequent it persists during the progressive stage of the disea and then drops to normal. But the fever may r appear at any moment, and this coincides with t extension of the pathologic process to other ly phatic glands in the same or in a distant zone. T blood-picture shows a mononucleosis of the lar cell type.

The poradenic tumour is of a wooden hardne firmly anchored to the surrounding structures, a on deep palpation elicits very little, if any, pa In nearly all cases the iliac lymphatic glands a found markedly enlarged, and at times to such extent that they form a mass as large as the o in the groin, but the pathologic process in the il nodes does not progress beyond the stage of infla matory congestion of the gland, and they ne break down, receding to normal *pari-passu* with improvement of the inguino-crural process. T skin glides freely over the tumour for several da but in the advanced stage becomes adherent to underlying mass, and when this occurs it may assumed that extensive suppuration has alrea taken place; at this period the palpating fin detects in the centre of the hard tumour a more less circular area of doughy or waxy softening p mitting indentation, and as the finger-tip sinks detects a firm ring surrounding the area of de seated softening. Eventually, a capillary fis forms, which discharges an insignificant amoun sero-pus and may close again in a day or two w out leaving a trace of its former location; this m be repeated several times before the fistula becon permanently established. Later, other fistu may form which drain different, isolated foci suppuration until the whole tumour may beco one necrotic mass discharging small amounts o sticky sero-pus through many sinuses. A fus of all suppurating foci such as occurs in other for of adenitis never takes place in poradenitis.

Resolution of a poradenic tumour which has progressed to the stage of extensive suppurat may take place, but the process is a very prolon one requiring months. The usual course leads fistulization and chronic suppuration. A charact istic of the discharging sinuses is the fact that borders show no evidences of inflammation *chancrellization*, the bordering skin appear normal. The amount of pus discharged is alw small, and after the first few days may be onl few drops in the 24 hours, but this suppuration apt to continue during many weeks or months. H ever, the patient once free from the acute sy ptoms of the disease, leaves his bed to lead for next few months the existence of semi-invalidi imposed by the essentially chronic course so char teristic of poradenitis.

Prognosis.

This is always good as regards life, but must always be guarded as to the duration of the disease. A poradenectomy or total excision of all glands involved is the only method which offers probabilities of a prompt cure, but even timely surgical treatment does not always prevent a recurrence in some other group of lymphatic glands. Left to itself, a well-developed case of poradenitis may take from six months to one year for complete recovery.

Treatment.

Ravaut claims to have used with success intravenous injections of Lugol's solution alternating with emetine. Emily uses intraganglionar instillations of a xylol iodoform and paraffin-oil mixture. Nicolas, Favre, Rost and Bory recommend radiotherapy in the early stages of the disease. In my experience all treatments, except a prompt radical operation, yield uncertain and unsatisfactory results. The operative treatment has been recommended by Favre, Gaté, Nicolás, Brault, Dugas, Chavanne, and others.

Obviously, simple incision, curettage and drainage of the main focus of suppuration cannot accomplish much in these cases and is not to be advised.

The operation of poradenectomy can be performed in the early stage of the disease under local anæsthesia, but general anæsthesia is to be preferred in advanced cases. All manipulations in the depths of the wound should be carried out with gentleness and care, as the tumour is not infrequently attached by firm adhesions to the femoral sheath, while the upper border of the mass is often found intimately attached to the structures forming the inguinal canal, and there is danger of lacerating the spermatic cord.

The largest tumour that I have extirpated (Case iii) weighed 92 grammes and measured 10 by 4 by 2·5 cm.

The enlarged iliac glands require no treatment, as the poradenic process affecting them recedes rapidly after extirpation of the inguinal tumour. In cases operated on early, before the involvement of many glands or the production of massive periadenitis, and in which suppuration is confined to the intraganglionar miliary abscesses, the wound may be sutured *in toto*, without drainage, being careful to suppress all dead space; in more advanced cases simple drainage must be supplied for the profuse lymphorrhœa which is sure to follow and last for several days. Healing by granulation in these cases is always slow, but especially so if any portion of the affected glands was overlooked at operation, which must be a thorough one if it is to succeed in shortening the duration of the disease; an overlooked poradenic focus will keep up suppuration and possibly act as a source of infection to other glands.

Incipient cases operated on early and closed without drainage are cured within 10 or 12 days. More advanced cases require from two to four or five weeks for complete healing, according to the size of the cavity left by the removal of the tumour. Secondary suturing after the lymphorrhœa has ceased materially hastens recovery.

Sequelæ.

The excision of a poradenic mass usually gives rise to an œdematous infiltration of the surrounding tissues with lymph, the extent varying in direct proportion to the number of glands extirpated, but it is generally confined (it has been so in all my cases) to the vicinity of the operative wound. This œdema progresses in extent for the first three or four days and then gradually recedes as the lymph finds new avenues of discharge and disappears in the course of ten to fifteen days. However, Chavanne, Ravaut, Pigeon et Tanton, Marion et Gandy, Gaté, Brouardel and Brault have reported cases of pseudo-elephantiasis of the genitals and lower extremities consecutive to the extirpation of the inguinal lymph nodes. This serious sequela has occurred weeks and even months after the operation and persisted for long periods of time, occasionally for life. This possibility, though remote, is a serious drawback to the operation, and should be clearly stated to the patient before its performance. The additional fact that it does not always insure against further extension of the disease to neighbouring glands or an invasion of the glands of the opposite side also militates against the operation, but until some other effective method of treatment is discovered, a radical poradenectomy must remain the method of choice. In spite of the risk involved, every one of the young men that I have treated preferred submitting to a radical operation that promised a quick cure rather than face the long and tedious period of semi-invalidism which entails the spontaneous evolution of poradenitis. The uniform success that I have had in my 18 operative cases has strengthened my conviction that every case of poradenitis should be operated on at once.

Conclusions.

Subacute inguinal poradenitis is an autonomous pathologic entity of unknown ætiology, distinct from all the other usual forms of adenitis but very closely resembling pathologically a tubercular adenopathy. In the tropics the disease attacks almost exclusively young men of the white race recently arrived from colder climates. It is endemic in certain zones, with occasional mildly epidemic exacerbations. These outbreaks seem to coincide with long periods of drought and extreme heat. A long prepuce and uncleanliness of the genitals strongly predispose to it. The disease is manifested by an adenitis of the inguino-crural glands, characterized by multiple intraganglionar purulent foci accompanied by periadenitic inflammatory lesions, of a hæmorrhagic and suppurative type, with the formation of dense and extensive periglandular adhesions.

All non-surgical treatments so far tried have failed to produce uniformly satisfactory results, besides entailing serious loss of time. Poradenectomy, or

the radical excision of all diseased glands, should be the treatment of election and constitutes the only procedure that promises a quick recovery.

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A Preliminary Report on the Control of Trachoma in the Philippine Islands (H. Velarde, R. Villafranca and S. Luna-Orosa, *Bulletin of the Philippine Health Service*, April, 1925).—While the result of the survey in the public schools for 1925 seems to show that trachoma among school children in Manilla is now under control and is on the decrease, trachoma still remains to be a problem which needs the serious attention not only of the Health Service but of the whole medical profession. Another factor which adds to the seriousness of this problem is the possible and probable importation of more cases into the country, more particularly from China and Japan, on account of the great number of these people that come to the islands. It is, however, a relief to know that the Immigration Law of the United States protects the Philippine Islands to a certain extent from the danger. The cases usually found in the Philippine Islands are of the chronic benign type; there are usually no serious complications observed or sequelæ left. The disease is more frequent in the males than females, and is generally found between the ages of 10 and 20 years.

Epidemic Bulbar Poliomyelitis. Report of Six Cases with one Necropsy (J. McEachern, *Journal of the Amer. Med. Assoc.*, January 9, 1926).—In a peculiar epidemic of poliomyelitis of the bulbar type, the cases all presented the common clinical symptom of paralysis of the muscles of the upper respiratory tract. There was no coincident paralysis elsewhere. A striking feature of several cases was the presence of a white, frothy mucous in the nose and throat. In agreement with the generally recognized severity of bulbar poliomyelitis two of the patients died, and in the others the clinical picture was for a time very grave. The constant involvement of the muscles supplied by the eleventh nerve is most unusual. The dissociation between clinical and pathologic findings is well exemplified in the case studied at necropsy, the most intense reaction occurring in the cervical cord rather than in the medulla. Paralysis of the sphincter vesicæ, of ten days' duration, occurred in one of the cases described, which also well illustrates the widespread distribution of the lesions.

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BRONCHOMONILIASIS.

WITHIN the last twenty years it has been ascertained that affections of the bronchi and lungs may be definitely associated with the presence of fungi in the sputum, and to the various conditions so produced the name of bronchomycosis is now applied. Of these fungi the organisms known as monilias have contributed most frequently to the number of cases of bronchomycosis which have been recorded, producing the form of bronchomycosis known as bronchomonilias, but with increasing knowledge and experience of these fungi, recent investigations have shown that quite a variety of fungi belonging to different species, genera, families and orders may also be encountered in these bronchomycotic infections.

Bronchomoniliasis was first described by Castellani in Ceylon in 1905, and since then it has been met with by many investigators not only in tropical and sub-tropical, but also in temperate regions. Thus, cases have been described in France by Pinoy, in South Africa by Pijper, in West Africa by Macfie, in Egypt and the Sudan by Chalmers, MacDonald and Farah, in Italy by Jacono and by Castellani, Douglas and Thompson, in America by Johns, Baggs and by Picoff and Simon, while a thorough study of the disease in India has been made by Taraknath Sur. The monilias which produce bronchomoniliasis are comprised of fungi which are characterized by the sporophores being simple or sub-simple and producing by constriction at their extremities a chain of large lemon-shaped conidia often provided with a disjunction apparatus. It would seem, however, that there is at present a general tendency to extend the term monilia so as to include all the organisms of the genus *Oösporaceæ* Saccardo 1886, the vegetative body or thallus of which appears in the lesions in the tissues, i.e., in its parasitic life, as a mass of mycelial threads or free-budding forms, some of the mycelial filaments being long and branched and often presenting arthrospores. In cultures on the ordinary laboratory media, i.e., in their saprophytic life, they mostly consist of yeast-like, roundish or oval bodies, while mycelial filaments are usually scanty. An investigation of the bio-chemical characters of the monilias shows that they often ferment glucose and other carbohydrates with the production of gas, and on the basis of these characters the monilias may be classified into several groups. It may be pointed out that monilias which present the same biochemical characters may differ enormously as regards pathogenicity, some producing a severe infection when inoculated into the rabbit or guinea-pig, whilst others appear to be quite harmless. A critical study of the symptomatology of the cases of monilia infection shows that they may be differentiated into two types, severe and mild, although cases of intermediate severity may also occur. The *severe type* of infection closely simulates, and may be mistaken for, phthisis. There is emaciation, hectic fever, and hæmoptysis. Physical examination of the chest reveals the presence of patchy dulness with fine crepitations and pleural rubbings. Cases of this type often have a fatal ending. In the *mild type* there is no fever, the general condition remains good. The sputum

is mucopurulent and free from blood and is often scanty. Physical examination of the chest is negative or merely reveals the presence of a few râles. After lasting for some weeks or months resolution may occur spontaneously or the severe type of the disease may supervene.

The diagnosis of bronchomoniliasis is based on the results of examination of carefully collected sputum showing the presence of monilias and the absence of tubercle bacilli. The sputum should be collected in a sterile receptacle after thorough gargling with warm sterile water, and it should be examined immediately. Microscopic examination of such sputum may reveal the presence of roundish or oval yeast-like cells, often presenting a double contour, and sometimes a few mycelial threads, or it may be quite negative and the fungus can only be found by the employment of cultural methods, which should never be neglected. The mere presence of a monilia in the sputum, however, should never be considered sufficient to establish the diagnosis of a primary bronchomoniliasis. It has been shown that when a monilia has been discovered in a sputum properly collected and examined three possibilities exist. In the first place the monilia, as shown by animal inoculation, is non-virulent and non-pathogenic. In such conditions the organism merely lives saprophytically in the bronchi, constituting a *saprophytic moniliasis*. Secondly, the monilia, though virulent, may represent a secondary infection, in which case intravenous injection into rabbits causes death of the animal, but intrapulmonary injection does not produce any nodular pulmonary lesions and the animal dies from a general monilial septicæmia. This *secondary moniliasis* is comparatively common in advanced pulmonary tuberculosis. Lastly, the monilia is the cause of the broncho-alveolar lesions, when intra-pulmonary injection in the rabbit produces a characteristic nodular condition in the lungs. This condition constitutes *primary bronchomoniliasis*. Whatever the variety of monilia concerned in the production of bronchomoniliasis the treatment consists in the administration of potassium iodide in fairly large doses, together with the exhibition of balsamics, particularly creosote. Incipient cases respond well to this treatment and in them the prognosis is usually good; in advanced cases, on the other hand, the prognosis must be more reserved. Autogenous monilia vaccines are apt to be disappointing, being only very occasionally useful.

When a patient who is not in a very advanced stage of the malady does not respond satisfactorily to the iodide-creosote treatment, further investigations into the ætiology of the condition should be carried out, with a view to discovering the presence of mixed infection, since cases of true mixed infection, for instance, bronchomoniliasis and bronchospirochætosis and bronchomoniliasis and bronchoanaeromycosis have been encountered, and in such cases the response to treatment has been unsatisfactory and the prognosis rendered more serious.

F. E. T.

Annotations.

Studies of the Resistance of the Chicken to the Nematode Ascaridia perspicillum (C. A. Herrick, *American Journal of Hygiene*, January, 1925).—It seems evident from the data presented that as chickens increase in age they become more resistant to the development of the nematode parasite *Ascaridia perspicillum*. The parasites developing in resistant chickens were more variable in size than those developing in hosts with low resistance. Parasites in chickens over 100 days old were not able to make a growth of over 0·1 mm. during the first ten days, while those in five-day old hosts made a growth of over 5 mm. Parasites in heavily infested chickens made less growth than in lightly infested hosts. Although parasites could be transferred from old to young hosts, they could not be changed from one old host to another. This suggests that they become specifically adjusted to their host. Thymectomy and the prevention of the flow of bile into the intestine had no effect on the growth of the parasites. The serum of one cockerel, when injected into young chickens, was effective in making them more resistant to parasitism. Young chickens when injected with other adult chicken serum, were less affected by the parasites, but were no more resistant to their growth. The removal of large amounts of blood, by cardiac puncture, from adult chickens, made them less resistant to the growth of parasites.

Endemic Goitre in New Zealand and its Relation to the Soil-iodine. Studies from the University of Otago, N.Z. (Ch. E. Hercus, W. N. Benson and C. L. Carter, *The Journal of Hygiene*, December, 1925).—The incidence of goitre among school children in New Zealand has been determined by the examinations made by one of the authors and by the officers of the School Medical Service, of over 80,000 children. The proportion of men of military age who were unfitted for active service on account of goitre was ascertained during the examination of over 135,000 recruits by the Military Medical Boards in the years 1916-1918. Additional information has also been derived from hospital records, by the number of operations for goitre. The amount of iodine has been determined in nearly 500 samples of a number of waters from mineral springs and town supplies.

It has been proved that the following relation is approximately true throughout the Dominion, viz., percentage incidence of goitre among school children is equal 6 plus the quotient of 360 divided by the amount of iodine in ten million parts of soil so long as this does not exceed 50, assuming defined methods of medical examination and chemical analysis. Further, the relation between the average amount of iodine in the soil and the percentage of military recruits medically rejected on account of goitre is of the same general nature, the latter figure being about one-twentieth of the incidence

among school children, though this proportion must also be diminished in regions in which iodine is particularly abundant. Approximately, therefore, the incidence of the disease is inversely proportional to the amount of iodine in the soil. Further, where, though the incidence of goitre is low, the amount of iodine in the soil is abnormally low, it has been proved that it is present in the water supply in greater amounts than usual, and the daily intake of iodine among the inhabitants of such a district is thereby maintained. Further, regions in which the average amount of soil-iodine is low are also those in which goitre is most frequently seen amongst the domestic animals.

The hypothesis that goitre is caused by a deficiency of iodine in the diet has been fully sustained by the present investigation, and that a relation holds between the incidence of goitre and the distribution of geological formations in New Zealand, Switzerland and perhaps in other countries. The administration of small amounts of iodine weekly as a prophylactic treatment of school children has had fairly good results, but the best method of prophylaxis is thought to be the daily ingestion of minute amounts of iodine, obtained by the utilization for all culinary and table purposes of an iodized salt, in which one part of potassium iodide had been added to 200,000 of sodium chloride—the method which has been attended by such satisfactory results in Switzerland. This would afford the minimum amount of 0·005 mg. per day, which seems necessary for the functional requirements of the thyroid gland, while it would be far too small to have any ill effects in the production of hyperthyroidism.

The Production of Albuminuria by Renal Vasoconstriction in Animals and Man (I. Starr, *Journal of Experimental Medicine*, January 1, 1926).—These experiments show that transient albuminuria follows the infusion of small doses of adrenalin into rabbits, if prolonged over several minutes. Agents causing renal vasoconstriction also cause transient albuminuria in anæsthetized, eviscerated dogs. Cats eliminate albumin after having been frightened or enraged. The drug ephedrine, which commonly causes vasoconstriction in animals, has been tested in man. Transient albuminuria followed its administration in those cases in which signs of renal vasoconstriction appeared; it did not in those cases in which such signs were lacking. Evidence was obtained that ephedrine is not intrinsically injurious to the kidney. The observed facts may be explained by the conception that renal vasoconstriction causes increase in the duration and extent of the normal intermittent interruptions in the glomerular circulation. Permeability of the glomerular membranes is so increased by these lengthened interruptions that when blood-flow is re-established albumin escapes. It is believed that this conception may apply to those albuminurias in man which result from excessive muscular exercise or emotion or which are produced reflexly. It may explain the occurrence of albumin in the urine of normal people and in healthy laboratory animals; it may play a part in the explanation of the albuminuria which occurs after anæsthesia or in cardiac decompensation. Its possible relation to orthostatic albuminuria has been discussed.

Microbic Virulence and Host Susceptibility in Paratyphoid-enteritidis Infection of White Mice. The Relationship of Dosage to Mortality Rate, Survival Time and Cage Population (Ida W. Pritchett, Sc.D., *Journal of Experimental Medicine*, February 1, 1926).—Epidemics of mouse typhoid set up among the Rockefeller Institute strain of mice were studied over a period of six months. During this time the relationship of cage number of mouse typhoid bacilli to mortality, total population, and survival time was determined. A single virulence titration of the epidemic strain was made, and at the end of the experiment all survivors were examined for evidence of infection. The following conclusions may be drawn from the data presented. The available dosage of mouse typhoid bacilli varied directly with the mortality (plus at a time constance of six to eight days) and inversely with the survival time. The virulence of the epidemic strain appeared to be practically the same as that of the original stock culture. About 53·5 per cent. of the survivors of one epidemic and 68 per cent. of those in the other showed, at the end of the experiment, no signs of infection; the others had either specific blood agglutinins, or living bacteria in their hearts' blood, spleen-fæces, or gall-bladder. During the course of the epidemic, the original infecting strain (mouse typhoid type II—*Bacillus pestis caviæ*) was almost entirely replaced by an antigenically dissimilar strain (mouse typhoid type I—*B. enteritidis*) probably introduced through the inadvertent inclusion of fæcal carriers among the normal mice added as contacts.

The Development of Onchocerca volvulus in Simulium damnosum (D. B. Blacklock, *Annals of Trop. Med. and Parasitology*, February 11, 1926).—*Onchocerca volvulus* infection is common in the Konno district of the Protectorate of Sierra Leone; larvæ of this parasite were found in the skin of 45 per cent. of persons examined systematically. A definite relationship between diseases of the skin or diseases of the eyes and the infection with *O. volvulus* as judged by the presence of larvæ in the skin could not be established. *Simulium damnosum* is very prevalent in the hilly country, which is covered with bush and grass, and has numerous streams and rivers; the lesion inflicted on the skin by this species in biting is such as would dislodge the larvæ of *O. volvulus* in the skin. Dissection of wild insects showed: (*a*) In 780 dissections of the gut an infection 2·6 per cent. with larvæ morphologically identical with those of *O. volvulus*. (*b*) In 1,320 dissections of the thorax a larval infection of over 1 per cent. By allowing wild flies to feed on restricted and heavily-infected areas of

the skin the gut infection was raised to 80 per cent. in one experiment, and the thorax infection to nearly 82 per cent. in another experiment; the developing forms of *O. volvulus* were found in the thorax after the infecting feed up to the seventh, eighth and tenth days, after which period no insect survived.

Madura Foot (Mycetoma). The Black Variety in a Native American (J. A. Gammel, H. Miskdijan and H. S. Thatcher, *Archs. of Dermatology and Syphilology*, January, 1926).—Report is made of an infection with the granuloma maduromycosis (mycetoma) in a native American from Texas. This is the twenty-first case reported from the United States and the eleventh from Texas. The infection was of the black grain variety—the first thus far reported in a native American and the second black grain infection reported on the North American Continent. All attempts at animal inoculations were negative—using monkeys (*Macacus rhesus*), rabbits, guinea-pigs, white rats, white mice and pigeons. Cultural experiments thus far carried out lead one to classify the causative organism with the Madurella group (Brumpt), and because of its characteristics as a new species the authors term it *Madurella americana*. A detailed description will be published later.

Recklinghausen's Disease without Tumour Formation. Incomplete or Abortive Forms of the Disease (F. Wise and J. J. Eller, *Journal of the American Medical Association*, January 9, 1926).—The cutaneous manifestations of Recklinghausen's disease consist, in a certain group of cases described by the authors, of nothing more than widely scattered pigment spots irregularly distributed on the trunk, buttocks and thighs. They vary from a light yellow to a deep brown, and from pinhead-sized freckles to extensive areas, large enough to cover a buttock or a thigh, or a large area of the trunk. This tumourless variety of the affection is usually encountered in one or more children of a family in which either parent has a typical neurofibromatosis cutis, as originally described by Recklinghausen. However, a pigmentary eruption without tumours may also occur in adults. To this variety of Recklinghausen's disease the terms "incomplete" and "abortive" have been applied, suggesting the assumption that as the disease progresses, tumours eventually will make their appearance. The terms neurofibromatosis cutis or fibroma molloscum multiplex are applicable only to those cases in which tumours form a part of the clinical picture.

The Ætiology of Chronic Ulcerative Colitis. Experimental Studies with Suggestions for a More Rational Form of Treatment (J. A. Bargen and A. H. Logan, *Archives of Internal Medicine*, Dec. 15, 1925).—A Gram-positive diplococcus has been isolated in 80 per cent. of cases of chronic ulcerative colitis. This organism was obtained in pure culture from the early lesions, in an acute exacerbation of the disease, from the depths of chronic ulcers, and occasionally from distant foci elsewhere in the body. By the intravenous injection of the organism, lesions like those in human beings are produced in rabbits and dogs, the lesions in the latter approaching the chronic stage of the disease in human beings. The finding of this organism in distant foci and the production of acute lesions in the colon could account for the repeated exacerbations of the disease and the pathologic findings of layer on layer of the granulation and fibrous tissue, replacing the colon mucosa. From these studies, it would seem that hope of control of this disease lies in (1) removal of the distant foci of infection; (2) immunization in some form against the causative organisms; (3) local and topical application and irrigation; (4) the empiric use of drugs, such as tincture of iodine: (5) the administration of some absorbent like kaolin by mouth, and (6) a non-irritating yet generous diet.

Sporotrichosis in Man. Report of a Case (F. J. Burgess, *Archives of Dermatology and Syphilology*, November, 1925).—A case of sporotrichosis occurring in a patient in Montreal is reported. Apparently this case represents a somewhat unusual type of the disease, and probably is best described as a single sporotrichotic gumma. The causative fungus is believed to be *Sporotrichum beurmanni*, notwithstanding certain definite variations. Of interest is the slow response to potassium iodide, a drug that usually results in a relatively quick involution of these lesions. A six months' course of treatment with large doses of potassium iodide was necessary before complete recovery resulted. The observation that in tertiary syphilis with gummatous lesions extraordinary large doses of potassium iodide may be taken without causing any untoward general symptoms raises the question whether here, too, such a lesion may not be able, so to speak, to take care of equally large amounts of potassium iodide without showing symptoms of iodism.

The Present Status of Hexylresorcinol as an Internal Urinary Disinfectant (V. Leonard and Austin Wood, *Journal of the American Medical Association*, December 12, 1925).—The investigations that have led recently to the development of hexylresorcinol and its application as an internal urinary antiseptic were begun about 12 years ago. In the use of hexylresorcinol the best results will follow only the strict observance of four controlling factors, all of which bear a close relationship to considerations of surface tension: (1) the dosage must be adequate; (2) fluids must not be forced; (3) sodium bicarbonate is contra-indicated for the reason that it raises the surface tension of the urine, and, like large quantities of water, thereby robs the urine of its bactericidal properties. Hexylresorcinol is equally

efficacious in alkaline and in acid urine; (4) the course of treatment with this drug must be proficiently prolonged. Among the organisms commonly found in urinary tract infections, those which are most resistant to surface tension changes in the test-tube (colon group) are most resistant to the action of hexylresorcinol *in vivo*. Urinary infections by *B. coli* and related types ordinarily require from 60 to 90 days' continuous treatment with the drug. If combined with the usual local measures, the course of treatment will be shortened and the percentage of ultimate cures increased.

Effects of Spontaneous Disease on Organ Weights of Rabbits (Wade H. Brown, M.D., Louise Pearce, M.D., and Chester M. Van Allen, M.D., *Journal of Tropical Medicine*, February 1, 1926).—A group of 27 rabbits presenting clinical manifestations of disease of spontaneous origin was studied with a view to determining whether any relation could be detected between physical constitution as represented by organ weights and functional activity as measured by the efficiency of the reaction to disease. The results of the investigation are presented by the authors in tabular form and the values obtained are compared by means of graphs, with corresponding values for normal rabbits. It was found that animals that were the subjects of disease showed decided changes in the weights of nearly all organs, changes which appeared to be of functional origin in that the values obtained for organ weights and co-efficients of variation tended to conform in general with the efficiency of the reaction displayed by the various groups of animals into which the entire series was divided.

The Effect on Paramecia of Blood-serums, especially from Patients with Carcinoma (G. A. Daland, *Archives of Internal Medicine*, Dec. 15, 1925).—Paramecia, when mixed with human blood-serum, form vesicles, the rate of formation being an index of the lethality of the serum. No specific substance was found in the blood-serum of patients with carcinoma which affected the rate of vesicle formation in paramecia in any way different from normal serum. Sera from diseased persons may resemble those from normal subjects in their effects on paramecia, or their toxicity may be greater or less. Serum obtained at the time of menstruation is slightly more toxic than at other times. Sera differing in their effects on paramecia may be made to act similarly by altering their concentration. Diluted sera, sera containing haemoglobin or that have been heated, sera irradiated with ultra-violet light, and sera of patients who have just received Roentgen-ray therapy are all less toxic for paramecia than the control sera.

Creeping Eruption (J. L. Kirby-Smith, W. Dove, and G. F. White, *Archives of Dermatology and Syphilology*, February, 1926).—Skin infestations in man by larvæ of *Gastrophilus hypoderma* and other flies has been reported from various countries, and it has generally been supposed that creeping eruption was caused by such larvæ. It is now seen that different skin diseases have been diagnosed "creeping eruption." Some of these are fly larvæ infestations (myiasis), others are due to a nematode of the genus *Gnathostoma* (gnathosto-myiasis), still another disease is caused by a different nematode. For the latter disease the authors have chosen the name "creeping eruption," leaving it to those studying the other creeping diseases to choose suitable names for them. It is this disease that is discussed in the present paper. The cause of creeping eruption is a nematode larva approximately one-fiftieth of an inch in length and one twelve-hundredth of an inch in breadth. It was recovered from each of five excisions, representing four patients and as many different localities. More than 200 excisions were made, and of these forty-eight were sectioned serially, making more than 40,000 sections. The causal nematode is reported here for the first time and described under the name *Agamonematodum migrans*. Some persons are more susceptible to infection than others. Whites are more susceptible than negroes. Infection occurs more often in children than in adults, and are most frequent during the summer following rainy weather. More cases occur during the vacation period of school children. Cases in persons most extensively infestated have originated underneath buildings when men at work were wet with perspiration and were in contact with the damp, sandy soil. Minor infections have often occurred in children playing in low areas, where apparently surface drainage had disseminated the parasites. No definite conclusion can be drawn regarding the host of the adult of the nematode parasite. The origin of some cases in proximity with sewage disposal suggests a possible relationship with intestinal worms of man, while other cases have originated at points distant from such likely sources of contamination. The evidence tends to indicate that rats might be the normal host of the adult worm. Poultry, cats, dogs and other animals may possibly be concerned. That insects are concerned in the transmission of the disease is possible. The inability to locate the parasite definitely has much to do with the difficulty in treatment. When the parasite has invaded the sole or the palm, the difficulty is increased. Ethyl acetate applied on cotton or gauze or used in a flexible collodion has been effective in many cases. Refrigeration with ethyl chlorid, carbon dioxid snow, or crushed ice with salt has been used successfully.

Ankylostomiasis among the Troops in the Dehra Dun (G. Covell, *Indian Journal of Medical Research*, January, 1926).—Results of a hookworm survey of the troops in Dehra Dun, 1925, are detailed. The Gurkha troops are very heavily infested, the percentage of the infestation among them

being twice as high as among the R.A. gunners and drivers recruited in the Punjab. It is suggested that a hookworm survey of all Indian troops be carried out as a preliminary to mass treatment of infested units. Clayton Lane's method of direct centrifugal flotation is recommended as being rapid, accurate, and easily carried out. It is also suggested that beta-naphthol would be the most suitable drug for mass treatment, and that a course of treatment be given two months after the end of the rains, and repeated before the ensuing monsoon.

On the Variation in amount of Soluble Protein contained in Old Broth Cultures of Bacillus typhosus (J. W. Cornwall, *Indian Journal of Medical Research*, January, 1926).—The amount of soluble protein in broth cultures of *B. typhosus* rises continuously to a maximum, which is reached after seven to twelve weeks incubation and then falls again. This protein is derived from the solution parts of the bodies of dead bacilli. Individual bacilli do not probably live long when they cannot obtain sufficient nutriment to enable them to divide. Owing to local variations in the concentration of nutriment in a broth culture bacilli are continually dying, while reproduction is as continually going on. As the concentration of nutriment falls, the generation time lengthens. The rise in the soluble protein curve indicates that a larger amount of protein derived from solution of bacterial bodies is being added to the fluid than is being abstracted by degradation of protein. The fall in the soluble protein curve indicates that degradation of protein by hydrolysis is proceeding more rapidly than protein is being added by solution of bacterial bodies.

The Healing of Gastric Ulcers (B. B. Crohn, S. Weiskopf, and P. W. Aschner, *Archives of Internal Medicine*, February 15, 1926).—In two cases in which partial gastrectomy was performed for gastric ulcer, operation was timed to take place at the end of a course of preliminary medical treatment. The specimens removed showed these ulcers in the last stage of healing. In one case Roentgen-ray examination just before operation showed the disappearance of the niche that had been present. So-called "essential gastric hæmorrhage" cases, if operated on soon after the hæmorrhage, may show negative findings; if followed over a course of years they may eventually be demonstrated to be true ulcer cases. It is suggested that the negative findings at the first operation are due to the rapid healing of the ulcer after hæmorrhage. The rapid regression of ulcers in the intermission period will explain many cases of negative findings at exploratory laparotomy in cases with a suggestive ulcer history. In a series of such cases in which operation was done at a later date during a recurrence of the symptoms, the patient showed definite ulcer. The failure to demonstrate the lesion of a gastric or duodenal ulcer at exploratory laparotomy may therefore be due, at times, to the fact that the operation is carried out at a period in the life-cycle of an acute ulcer when rapid regression and healing have obliterated the ulcer crater and made the lesion impossible of discernment.

Current Literature.

Bulletin de la Societe de Pathologie Exotique, November 11, 1925.

The Intestinal Parasites in Natives of the Military Colonial Corps in France. Treatment and Prophylaxis (J. Emily).—Examination was made of troops of three different corps, i.e., Indo-Chinese, Malagash and Senegalese. The total number of examinations was 2,987, of which 906 were Indo-Chinese, 1,206 Malagash and 875 Senegalese. The percentages of those harbouring parasites were as follows: 88·96, 78·35 and 67·08 respectively. Thymol and tetrachloride were both efficacious in treatment. Measures will be taken to examine and treat all colonial natives on their arrival in France. The usual methods of prophylaxis are recommended.

Spirochætosis of Fowls in Greece (M. Stylapanopoulo).—This affection has never previously been reported in Greece. It occurred in epizootic form last summer in a number of fowl-houses in the neighbourhood of Athens. Both young and old animals were attacked and the rate of mortality was high. The affected animals cluster together, their feathers are ruffled and their combs are pale. They refuse all nourishment, but show marked polydipsia. There is very intense, greenish diarrhœa. They rapidly become thin, and, if the symptoms do not ameliorate, the animals die in a state of coma in about four to five days. At autopsy the liver is enlarged and there is fatty degeneration. The pericardium is slightly inflamed and contains a liquid exudate which coagulates on exposure to air. Numerous spirochætes are found in the blood, after staining with gentian-violet or Giemsa's stain. The malady has been transferred experimentally from a hen to a cockerel. The transmitting agent is *Argas reflexus*.

A Sanguicolous Spirochæte in a Domestic Dog (R. Bosselut).—The dog in this case came from Marengo, Algeria; there were signs of anæmia and the animal refused to eat. Temperature normal. Examination of blood showed numerous spirochætes, which the author has named *Spirochæte canina* nov. sp. Experiments to transmit the infection were negative. This is claimed to be the first case in which spirochætes have been found in domestic dogs.

Extraperitoneal Amœbic Abscess Simulating Appendicitis (Mme. A. Panayatotou).—The patient, aged 40 years, entered the hospital at Alexandria to be operated on for appendicitis. When the incision was made in the wall of the abdomen

large amount of pus extending to the right iliac was found, while the appendix was quite normal. Microscopic examination of the pus showed numerous *Amœba histolytica*. The patient did well. Owing to the extra-intestinal localization of the amœbic abscess it was thought that other organs might be affected; there was no cough or expectoration and all the organs were normal. Examination of the stools showed dead amœbæ and cysts. Injections of emetin and stovarsol were given.

The Action of Quinine on the Schizonts of Plasmodium malariæ (H. G. S. Morin).—Five cases of quartan fever have been closely watched in the hospitals of Marseilles, in order to follow the progress of the disappearance of the parasite under the action of the prescribed quinine treatment. *P. malariæ* is a particularly good material for such a study on account of the richness of its evolutive polymorphism. In three of the cases it took more than forty-eight hours for the parasites to disappear from the patient's blood; from the seventy-second hour there was less than one parasite per 200 fields, and from the fourth day the examinations were constantly negative. In the other two cases the parasites became very rare in less than twenty-four hours. When the patient is simply kept in bed the infection diminishes slowly but surely. The beginning of quinine treatment is marked by an immediate diminution in the number of parasites, and the larger the dose employed the quicker the disappearance. The cure of quartan fever is better brought about by prolonged treatment with quinine rather than by increase of the doses.

Blackwater Fever Syndrome during the Course of an Attack of Malaria (C. Vialette).—The interesting points in this case are, that it occurred in France, a country where blackwater fever is very exceptional, and during the period of the invasion of malaria in a patient who had never previously had the affection. It yielded to quinine therapy and did not recur under the influence of large doses.

An Epidemic of Yellow Fever in Liberia (G. Bouet).—Until recently Liberia was considered to be free from yellow fever. The epidemic broke out May 25, 1925; the first case was the cashier of an English navigation company, and the malady was diagnosed as cerebral malaria. Six other cases observed by the author are minutely described, all of which ended fatally, and they leave no doubt as to the nature of the disease. The author has observed the existence of *Stegomyia* in Liberia since 1918.

Note on Kala-azar of Honan, Central China (G. Villain), October 14, 1925.—The lower basin of the Yellow River, investigated by the author, is deeply infested with visceral leishmaniasis and constitutes a vast field of study for future experiments. The greatest handicap at present is the lack of laboratories and co-operation amongst medical men of the same nationality.

These observations have proved the innocuity of hepatic puncture in kala-azar; it did not cause any accidents in any of the patients treated, and it clearly showed typical leishmania in numbers sufficient to assure an almost immediate diagnosis. Nicolle's method was used. Tartro-bismuth is not reliable in this disease and often cause stomatitis. Antimony is the only active remedy, but it is not easy to carry out the necessary prolonged treatment by intravenous injections. Examination for the parasite in the stools, urine, sputum, &c., was negative, but in one case *Leishmania* were present in an old cutaneous ulcer. No definite conclusions are reached as to the transmission of Chinese leishmaniasis. Research for flagellates in the intestine of bed bugs gave negative result.

Contribution to the Posology of Stovarsol:—*Hebdomadal Doses of Stovarsol in Yaws* (G. Lefrou, October 14, 1925).—Very good results have been obtained in the treatment of yaws by stovarsol. The dose for adults was 2·5 to 3 gr. every seven days; it was well tolerated and caused no accidents. In some cases 4 to 5 gr. were given, according to the weight of the patient; larger doses cause febrile reactions and diarrhœa. All the patients increase in weight during treatment. For children a dose of 0·09 gr. per kg. can be given three times with a week's interval.

Reviews.

MANUAL OF EMERGENCIES, by J. Snowman, M.D. Price 10s. net. Published by John Bale, Sons and Danielsson, Ltd., 83/91, Gt. Titchfield Street, Oxford Street, London, W.1.

The second edition of this work now lies before us. The first edition was published in 1919 and was founded on Lenzmann's "Emergencies in Medical Practice," but the text was so entirely re-written and the subject matter was so extensively revised that the author claimed that the manual might fairly be treated as a new work, representing the teaching of standard British authorities on medical, surgical and obstetric emergencies. The second edition has not only been thoroughly revised, but has been issued in a new format, being published on thin paper, so as to reduce the volume of 371 pages to pocket size, so that it may be really at hand and available in all emergencies. The new material embodied in this edition includes the insulin treatment of diabetes, the serum treatment of botulism, quinidine sulphate in auricular fibrillation, the surgical treatment of angina pectoris, and Strogonoff's treatment for eclampsia. The practitioner, in whatever part of the world he may practise, will find this little volume extremely useful when faced with any of the emergencies he is liable to encounter. F. E. T.

REPORT TO THE SECRETARY OF STATE FOR THE COLONIES ON THE SANITARY CONDITION OF THE MINES AND MINING VILLAGES IN THE GOLD COAST COLONY AND ASHANTI. By Professor Sir William Simpson, C.M.G., M.D., F.R.C.P., D.P.H. Published by the Crown Agents for the Colonies. 1925.

This is a masterly report from a practised hand. It is divided into three parts. Part I contains a general account of the mines, the labour they employ, the causes of the high death-rate, and the remedial measures. Part II gives details relating to each mine and mining village. Part III contains Sir William Simpson's recommendations for the reorganization of the Public Health Department of the Gold Coast, and embodies much sound constructive criticism. Much reliable information is also contained in a number of appendices, which give temperature readings of the dry and wet bulbs, and results of dust samples in various mines; results of the examination of children's blood for malaria in several of the mine villages, and a summary of fæces examinations for helminthic infestations in hospital patients in Secondee and Coomassie and in latrines in mines and mine villages and in Accra. A number of elaborate plans and excellent photographs completes this model report.

F. E. T.

AN ELEMENTARY COURSE IN TROPICAL HYGIENE. Part II. By Mary G. Blacklock, M.B., B.Sc., D.T.M., lately Medical Officer, Sierra Leone, West Africa Medical Service. Preface by Andrew Balfour, C.B., C.M.G., M.B., B.Sc., F.R.C.P., Director, London School of Hygiene and Tropical Medicine.

We have already noticed Part I of this little work, which was meant for quite small children. Part II covers much the same ground, but is meant for somewhat older children, for students in training colleges, and for all those who, like nurses, health visitors and junior sanitary officials, require a knowledge of tropical hygiene written in simple non-technical language. There are also two supplementary chapters for older students, dealing respectively with inoculation and vaccination and the Public Health service. The opening chapter, on the value of hygiene, as Dr. Balfour points out, is well conceived, and is fitted to impress the youthful intelligence with the importance of paying attention to the laws of health, the arguments used being backed by illustrations of the successes achieved by hygiene in various parts of the world. The rest of the book is equally good, being concise, practical, accurate and to the point. In fact, the book must be judged a great success.

F. E. T.

E. MERCK'S REPORT ON RECENT ADVANCES IN PHARMACEUTICAL CHEMISTRY AND THERAPEUTICS, 1917-1921, is the English dress in which Merck's *Jahresbrichte* for these years appears. Much useful information—both clinical and experimental—on new and important drugs is contained in this volume in an interesting form and rendered easily accessible. Bayer 205, silver, salvarsan, novarsenol and sanocrysin are drugs information about which will be welcome to our readers. The volume forms a convenient work of reference in handy form on the newer drugs, and there can be very few who cannot find something to interest or instruct them within its pages.

F. E. T.

MEMORIA DE LA CAMPAÑA CONTRA EL PALUDISMO (1923-1924). (Report on the Campaign against Malaria, 1923-1924). Published by the Ministry of Health, Madrid, 1925.

This report, with its excellent maps and pictures, shows that though much is being done in the way of antimalarial work in Spain, much remains to be done, the malarial mortality in Caceres, the most severely infected province, having been 56·4 per 100,000 in 1923 and 43·3 per 100,000 in 1924. The central commission for antimalarial work is still continuing its successful labours.

F. E. T.

Medical News.

THE UNIVERSITY OF LIVERPOOL.

EXAMINATION LIST. MARCH, 1926.

Diploma in Tropical Medicine.—W. J. Aitken, M.B., Ch.B.; A. Ashworth, M.B., Ch.B.; R. N. Bansikar, M.B., B.S.; N. Bligh-Peacock, M.B., Ch.B.; Effie G. Bolton, M.B., Ch.B.; E. H. Boodrie, L.R.C.P., M.R.C.S.; M. A. B. Brohier, Mutunayagam, L.R.C.P., M.R.C.S.; T. Carter, M.B., Ch.B.; H. N. Davies, M.B., Ch.B.; B. G. V. Dias, L.R.C.P.S.(Ed.), L.R.F.P.S.(Glasg.); E. G. A. Don, M.B., Ch.B.; H. P. Fowler, M.B., Ch.B.; Isabella J. Fowler, M.B., Ch.B.; Katharine M. Hodgkinson, M.B., B.Ch.; R. Jackson, M.B., Ch.B.; K. H. Kamakaka, M.B., B.S.; D. Lees, M.D.; A. W. Lewis, L.R.C.P., M.R.C.S.; A. G. Mackay, M.B., Ch.B.; N. McLean, M.B., Ch.B.; M. MacSweeney, M.B., B.Ch., B.A.O.; S. B. Malik, L.R.C.P., M.R.C.S.; M. E. Merck, M.B., B.S.; E. F. Molony, L.R.C.P., M.R.C.S.; S. G. Nashikkar, M.B., B.S.; F. Oppenheimer, M.B., Ch.B., I.M.S.; F. S. Paterson, M.B., Ch.B.; L. D. Quigley, M.B., B.Ch., B.A.O.; M. Rodrigues, M.B., B.S.; A. S. Sachdev, M.B., B.S.; B. Singh, M.B., Ch.B.; J. Singh, M.B., B.S.; S. A. Tahir, M.B. B.S.; C. L. Tan, L.R.C.P.S.(Ed.), L.R.F.P.S.(Glasg.); Catharine F. Taylor, M.B., B.S.; N. S. Turnbull, M.B., Ch.B.; B. K. Vardy, M.B., B.S.; *T. N. Varma, M.B., B.S.

Diploma in Tropical Hygiene.—G. Clark, M.B., Ch.B.; Ivy Collier, M.B., B.S.; B. L. Davis, M.B., Ch.B., R.A.M.C.; A. J. Hawe, M.B., Ch.B.; D. M. Mackay, L.R.C.P., M.R.C.S.; N. McLean, M.B., Ch.B.; M. MacSweeney, M.B., B.Ch., B.A.O.; D. A. Skan, L.R.C.P., M.R.C.S.

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* Recommended for Milne Medal.

Original Communications.

THE WHITTINGHAM (W) STRAIN OF ARTIFICIALLY INDUCED MALARIA.

OBSERVATIONS MADE DURING THE TREATMENT OF GENERAL PARALYSIS AND TABES DORSALIS.

By A. R. GRANT, M.D.Aberd.,
Deputy Medical Superintendent,
AND
J. D. SILVERSTON, M.B., B.S.Durh.,
Senior Assistant Medical Officer, The County Mental Hospital, Whittingham, Preston.

THE treatment of general paralysis of the insane by malaria has been carried out in this hospital since July 21, 1922, and several observations on the value of this form of therapy in the disease have been made by us [4], [5], [6] from time to time. In this short note we wish to draw attention to some of the characteristics and behaviour of a strain of malaria which has now reached the fourth year of its existence and which still retains all its former potency and therapeutic value.

After preliminary work with strains of quartan, malignant tertian and simple tertian fevers we came to the conclusion that the latter was the most useful for our purpose, and so the birth of the Whittingham (W) strain took place on September 8, 1922, when a general paralytic was inoculated with blood from a patient who had contracted benign tertian malaria in India. From this host a long chain of cases of general paralysis and tabes has been infected, with the result that during the last forty-two months (three and a half years) the strain has been transmitted by direct subcutaneous inoculation through sixty generations, comprising over one hundred and fifty cases. Anopheline mosquitoes (*maculipennis* and *bifurcatus*) were infected with *Plasmodium vivax* by feeding them on patients in the twelfth and sixteenth passages of the strain. These mosquitoes were subsequently used to infect two of our cases, namely, one case of tabes dorsalis and one case of dementia præcox. Two more malarial stems of the simple tertian type were thus obtained, and as one originated in a non-syphilitic case of dementia præcox, we decided to name our strains of tertian malaria Whittingham (or W), W I and W II respectively. The strains W I and W II were allowed to die out; the former in a syphilitic host, was not further utilized, and the latter was stopped after several successful passages in non-syphilitic psychoses led us to believe that malaria was not a therapeutic measure of value in these cases. Again, with the introduction of the Pötzl [1] [10] method of inoculation, which in our hands has been successful with infected blood kept outside the body at 0° C. for varying periods up to seventy-two hours, we have enabled other hospitals in the country to commence and make observations on this form of treatment. The W strain in this way has been of service in the following general and mental hospitals: Leavesden, Exeter, Cardiff, Shrewsbury, Birmingham, Bradford, Cheddleton, Morningside, Cheadle Royal, York, Sunderland and the Liverpool School of Tropical Medicine.

Artificially induced malaria was obtained by injecting usually 2 c.c. of recently drawn venous blood from an infected source into the subcutaneous tissues of the host. As a general rule this operation was not followed by any constitutional or local reaction, but in a few cases fever (a temperature up to 101° F. on the second or third day), frontal headache and soreness at the seat of inoculation were encountered.

The incubation period, calculated from the date of inoculation to the day of appearance of parasites in the peripheral blood-stream, has been fairly constant, and although varying occasionally between six and twenty days, averaged from ten to twelve days throughout the period. In five cases, two inoculations were required before the fever and parasites appeared. These failures, after primary inoculation, were evenly spread over the "life" of the strain under review, and cannot be satisfactorily explained. Seizures of an epileptiform or apoplectiform nature have occurred during the incubation period, and on each of the three occasions we have considered it wise to prevent infection taking place and to reinoculate at a later date.

Ronald Ross [8] mentions that Ben-Harel has shown that in a series of blood inoculations of canaries with proteosoma, the red blood-cell count begins to diminish even as early as the day after the inoculation and long before the parasites become sufficiently numerous in the birds' peripheral blood to be detected. The decline was progressive day after day, until from one half to two millions of erythrocytes disappeared from the normal count (4·5 to 5 millions per c.mm.), when the parasites were discovered in the peripheral circulation. Daily erythrocyte counts were made on a series of seven male general paralytics before and after the inoculation and every day until *P. vivax* was demonstrated in the blood-films. The drop of blood in each case was taken from the finger two or three hours after the mid-day meal, and an average of three counts recorded. On the first day after inoculation there was a reduction in four cases, and an increase in the remainder; on the second day a reduction took place in five cases; on the third day in four counts, and on the fourth day a drop in five instances. In Case 4 there was an erythrocytosis for four days. On the sixth day and up to the day of appearance of parasites, the erythrocytes showed a diminution in all the cases. The lowest counts were recorded usually between the fifth and eighth days inclusive and averaged 3,100,000 cells; the reduction, however, was never progressive.

The commencement of the fever generally preceded the appearance of parasites in the peripheral circulation by one to four days; often parasites and fever coincided in the day of their appearance, while occasionally *P. vivax* forestalled every sign

of approaching fever by two to four days. The fever began usually with an increased pulse-rate and an elevation of temperature to 99° or 100° F., which mounted gradually for the next two or three days to a maximum of 103° or 105° F. before subsiding to the normal. This form of irregular pyrexia generally preceded and formed an introduction to the development of the malarial rigors whole period, but less so at the present moment as the pure tertian type is becoming more common. As many as three paroxysms of fever have taken place in the short space of twenty-four hours, but fortunately for the patient the occurrence is uncommon. (Figures 1 and 2 show typical quotidian and tertian fevers.)

In order to study more closely the changes

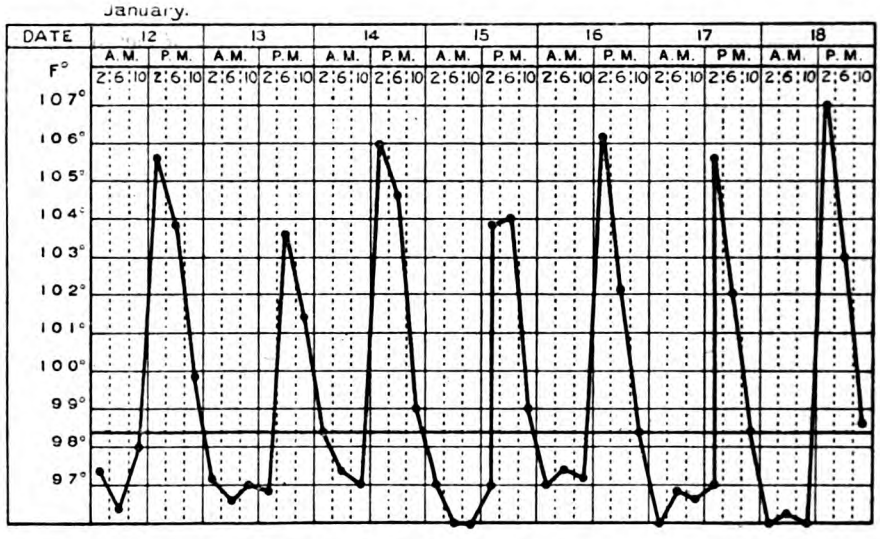


FIG. 1.—Typical quotidian curve.

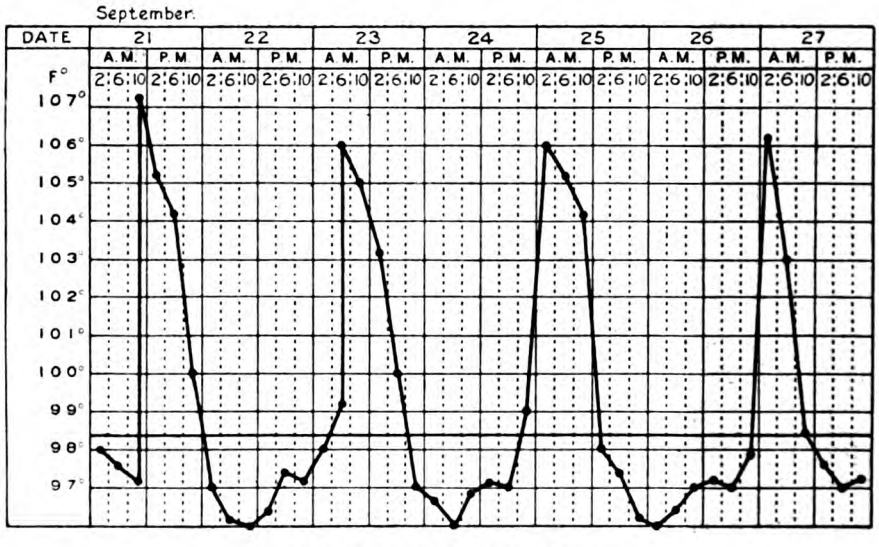


FIG. 2.—Typical tertian curve.

that invariably followed in their regular sequence. Rigors, although often slight in degree, appeared in some cases without any preliminary warning and waxed in intensity as the fever continued.

In the early and middle passages of the strain the types of fever in order of frequency were quotidian, a mixed type of tertian and quotidian, and pure tertian. The quotidian fever, or tertiana duplex, has appeared most frequently during the temperature during the various stages of paroxysm, a series of patients were put on "continuous" chart. That is from the date inoculation to the day of the disappearance parasites, the temperature, pulse- and respirati rate were taken at intervals of half an hour recorded. In this way several interesting obser tions were made. For instance, we found t quite often the temperature showed an eleva

of 2° to 3° F. above the subnormal interval range for an hour or two before the rigor actually took place, and less frequently, a rise of temperature ranging between 99° and 104° F. for a period of four to six hours suggested the same approaching phenomenon. In many cases the rigors were atypical and the rise of temperature or the stage of sweating were the only criteria that a paroxysm of malaria had taken place. On the whole, the stages were clearly cut and observed a certain proportion to each other; as a rule, the more pronounced the rigor the higher the fever and the more profuse the sweating. The maximum temperature of the paroxysm was reached in one half to three hours and varied in height with the number of the rigor; generally, the highest maximum was seen in the third, fourth or fifth, and ninth and tenth rigors, but this variation did not always hold good. The highest maximum temperatures recorded in the cases of the early stages of the strain ranged between 103·6° and 106·2° F. and at the present stage vary between 105° and 107·2° F. During the sweating stage the temperature gradually came down to normal, taking longer (from nine to seventeen hours) in the early than in the later rigors (from five to eight hours).

Stephens *et alia* [11], in 1921, studied the times of onset of one thousand paroxysms of simple tertian fever in mosquito-borne malaria, and came to the following conclusions:—

(*a*) Over 90 per cent. of the paroxysms occurred during the hours of activity (7 a.m. to 6.59 p.m.)

(*b*) The maximum number of paroxysms occurred at 2 p.m.

(*c*) Alteration of the period of activity by one hour, the result of the adoption of summer time, produced a corresponding alteration in the time of incidence of the paroxysms.

Now in our cases the conditions were markedly different, as, firstly, the inoculations were carried out in almost all the cases during the day, and, secondly, the patients were restless and mentally active by night as well as by day. An analysis of 500 paroxysms was made and the following data are available for contrast:—

In the winter months 85·2 per cent. of the inoculations were carried out between 11 a.m. and 3 p.m., and 81·4 per cent. of the paroxysms occurred between 7 a.m. and 7 p.m; the maximum number of paroxysms occurred at 2 p.m.

In the months when the summer time was in force, 86·9 per cent. of the inoculations were performed between 11 a.m. and 3 p.m., and 74·7 per cent. of the paroxysms occurred between 7 a.m. and 7 p.m.; the maximum number of paroxysms occurred at 2 p.m. and 5 p.m.

A few inoculations were performed at midnight in the anticipation that by this measure most of the paroxysms would occur during the night or early morning. The alteration in the time of inoculation did not alter the times of onset of the rigors and so the practice was discontinued. The onset of the chills may show a definite time relationship to each other during the course of the fever. Very frequently one may see from the examination of charts from cases of tertiana simplex that the individual rigors tend to anticipate in time of appearance the previous rigor and so on, throughout the course, whereas in quotidian fever both anticipation and delay in the times of appearance may be encountered. Atypical charts were met with in three patients at their first inoculations. In each case an apyrexial interval (with diminished number of parasites present in the films) intervened between the early and late paroxysms, so that the charts read in this fashion:—

Case S. C.—Rigor (first), four apyrexial days, seven rigors (quotidian and tertian), thirteen apyrexial days, three tertian rigors and quinine.

Case P. S.—Nine tertian rigors, fifteen apyrexial days, three quotidian rigors and quinine.

Case W. L.—Five tertian rigors, five apyrexial days, seven quotidian rigors and quinine.

The question of the number of paroxysms that should be permitted in individual cases has always been of engrossing interest to us and of paramount importance to the patient. Our early cases were permitted to have as many as five to twenty-four paroxysms (chiefly from ten to twelve), but we soon came to the conclusion that a patient who was going to get better would do so after treatment with five rigors as with fifteen, and at the same time would be spared an unduly prolonged fever with its likely train of complications and sequelæ. Again, from a histopathological study of the brains of successfully treated cases of general paralysis of the insane, Straüssler and Koskinas [12] have found that at least five malarial crises are required before changes are initiated in the cerebral cortex to bring about a condition simulating the "stationary paralysis" of Alzheimer. Further, the reduction in the average number (from seven to eight) of rigors permitted has not been followed by a corresponding drop in the rates of recovery or improvement, so that our practice of allowing no fewer than five, but not more than ten, paroxysms of malaria has been apparently justified.

General paralytics and patients suffering from tabes dorsalis generally tolerate this form of fever extraordinarily well. In a small percentage of cases, prodromal phenomena in the nature of various sensory disturbances may make their appearance and herald the approach of a paroxysm. These subjective sensations occurred in tabetic and non-tabetic patients, and varied from a dull ache in the leg bones, especially the tibiæ, to the severe and lancinating pains in the joints or cramp-like pains in the calf muscles. Very often pains continued during the cold and hot stages of the paroxysm, and disappeared as soon as perspiration commenced. The physical signs that accompanied the recurring paroxysms of the fever were apparently similar to those observed in mosquito malaria, but mental reactions were naturally expected to occur more frequently in our patients and often did so in the later rigors. Delirious

states, hallucinations of sight and of hearing, paranoidal ideas and severe emotional outbursts with intense restlessness were encountered and, as often as not, exhibited a tendency to become more prominent in the hot and sweating stages of two or three paroxysms and then disappear. Several reactions in the nature of paralytic seizures complicated the picture in four cases. Herpes was quite common and appeared usually about the lips, less frequently about the nose, angle of the jaw, or malar bone. Attacks of gastro-enteritis with vomiting and diarrhœa were occasionally present, but they were never severe in type and always responded quickly to treatment. Sub-icteric staining of the skin and mucous membranes occurred in the final paroxysms of a few cases; the iodine and Gmelin tests of the urine were negative, but often the Russo reaction was positive; the blood-serum had a yellowish tinge and gave positive readings with the indirect reaction of the Van den Bergh test. Clinical jaundice with bile in the urine occurred in four cases at the thirteenth, thirty-first, thirty-second and thirty-ninth passages of the strain. The condition, which is always of serious significance and of grave prognostic import, appeared following the fifth, but nearly always after the seventh paroxysm. As a severe infection of the blood-stream with rapid and abundant hæmolysis of the red cells was suspected, the treatment was immediately brought to a close by the institution of quinine therapy. In three of the four cases the bile in the urine disappeared after three doses of quinine had been given, and at the end of a week no trace of bile staining of the tissues could be seen. The fourth case, which was also the thirteenth host, did not do so well and passed on to a fatal issue on the day after the jaundice appeared. In one instance, where the treatment was prematurely arrested because of this complication, a reinoculation was successfully performed at a later period, when the patient passed through a complete course of fever therapy without showing any signs of jaundice. Daily examinations of the urine revealed generally a darkly-coloured urine, acid in reaction and of increased specific gravity. Albuminuria was common, but usually no more than a trace was the rule; a marked increase occurred in two cases associated with pronounced constitutional reactions and indicated immediate stoppage of the treatment. Glycosuria (1 to 1·5 per cent.) was rare. The Russo reaction may be positive prior to the appearance of bile and was associated with sub-icteric staining of the tissues. Urobilinogen was slightly but infrequently increased. Hæmoglobinuria [9] fortunately did not occur. Enlargement of the spleen, as far as could be ascertained by palpation and percussion, was always slight even during the paroxysm; this was also confirmed in cases which came to necropsy. At the end of the fever there was usually a loss in weight, varying in individual cases from one to eight pounds, with an average of four pounds. Occasionally a gain in weight actually took place. Pallor of the skin and a mild degree of secondary anæmia were observed in most of the cases during the final paroxysms or at the end of the fever. As a general rule, the condition cleared up very quickly with the administration of quinine, and at the end of a week the blood-picture became normal. One of our cases, however, developed a profound anæmia with a dirty yellow tinging of the skin at the eighth paroxysm of a quotidian fever; the usual dosage of quinine was given, and although the parasites quickly disappeared the blood-picture did not appreciably alter, but closely simulated that often observed in pernicious anæmia. There was a marked reduction in the number of red cells (2,500,000), a leucopenia of 3,500 whites, a reduction of hæmoglobin to 20 per cent., numerous microcytes and megalocytes, normo- and megaloblasts (few), poikilocytosis, polychromasia and punctate basophilia. Arsenic, given orally and by the intravenous route, rapidly improved the condition and at the end of fifteen days the anæmia had completely disappeared. Deaths within a month of completion of the fever course occurred in eleven cases and formed 55 per cent. of the total number of deaths in adequately treated cases over a period of three and a half years.

The morphology of the parasite (*P. vivax*) was carefully studied in over ten thousand blood-films that were taken in all cases at every stage over a period of three and a half years; and we found that the parasite retained the form and characteristics of that seen in naturally infected cases and, despite the number of transmissions through the vertebrate host, crescents were never found. Schüffner's dots in infected red cells were common. The number of parasites varied enormously in individual cases and at the different stages of the paroxysm and fever. The most common form of the parasite to appear at the commencement of the fever was the trophozoite; later, schizonts and gametocytes were seen. The parasites showed a general tendency to multiply rapidly with the fever and to reach a maximum about the sixth or tenth day of the illness, when often a progressive diminution in numbers would set in and in some cases lead to the complete disappearance of parasites from the peripheral blood-stream. Cases in which spontaneous auto-immunization developed during the course of the fever presented these features and were frequently encountered. Multiple infections of the red cells were seen in several cases at different stages of the strain. The red cells usually contained more than one parasite and often as many as six or seven were counted; occasionally two gametocytes, two schizonts, or a gametocyte and schizont might be seen inhabiting the same red corpuscle. Pigmented leucocytes and white corpuscles containing parasites in all stages of degeneration have been found in the later paroxysms.

The susceptibility of induced malaria to treatment with quinine is remarkable. After a three-day course of treatment by the oral administration of hydrochloride of quinine—30 gr. on each of three consecutive days—the fever quickly subsides and the parasites rapidly disappear from the circulation. The quinine did not always prevent

the next succeeding paroxysm, but nearly always postponed the time of onset and diminished its severity. The parasites show an extraordinary diminution in numbers after the first dose of quinine and as a rule completely disappear by the end of the third day. It is this remarkable susceptibility of the parasite to quinine that renders control of the fever practically impossible. In a few cases the fever and parasites exhibited a tendency to disappear spontaneously and without treatment by quinine. Spontaneous auto-immunization of this nature took place in certain patients inoculated for the first time, and generally developed between the fifth and tenth paroxysms; the immunity, however, was not always complete, as frequently parasites increased in numbers and paroxysms reappeared within twenty-one days. Vagaries of this kind were, however, much more common in several of the seventeen cases which received a second course of treatment. The reinoculations were performed at periods varying in individual cases from twenty-two days to nineteen months after the primary injection; parasites were observed in the peripheral blood-stream of *all* the cases, and in 58·8 per cent. of the series several paroxysms of malaria occurred at regular and irregular intervals. Again, the fever and parasites spontaneously disappeared in nearly all the cases and the administration of quinine was rarely required. Our results at this stage are interesting, as Nicole and Steele have reported complete failures in the same undertaking with similar types of patients. It seems reasonable to suppose that an attack of induced malaria sets up an immunity process in the host which renders him partially or completely immune to a second infection—the maximum protection was required in our cases about the ninth or twelfth month after the first course of fever treatment.

Relapses in inoculated malaria are uncommon and accounted for two cases, or less than 2 per cent. of the patients infected with this strain during an observation period varying from two months to three and a half years. The first case, which has already been reported elsewhere [6], relapsed forty-two days after the last dose of quinine (total 90 gr.) and eighteen days following the fourth injection of novarsenobillon. The second patient relapsed twenty-eight days after parasites had disappeared following the administration of a short course of quinine (total 60 gr.). Both the cases were treated by the usual three-day course of quinine and no further relapses have been reported. The infrequency of relapses in this form of malaria emphasizes strongly the necessity of maintaining a strain of pure tertian for therapeutic purposes. Davidson [2] inoculated twenty cases of general paralysis of the insane with infected mosquitoes and reported thirteen (56·5 per cent.) relapses within an observation period of twelve months. Again, Yorke and Macfie [13], and later Yorke [14], reviewed a series of thirty-seven patients similarly infected, and reported twenty-one (57 per cent.) relapses in a period of observation varying from 291 to 609 days, and in the great majority of the twenty-one cases, relapses recurred after treatment. Evidently mosquito malaria is more resistant to quinine than the inoculated form.

We have been informed that many trypanosomes pathogenic to man and stock undergo a marked increase in virulence to certain species of laboratory animals when maintained in them for long periods by direct inoculation from one host to another. In some cases the alteration in virulence was attended by certain morphological changes which took place only after the strain had undergone a certain number of direct passages in the vertebrate host. It was therefore of considerable interest and importance to know whether the prolonged sojourn of *P. vivax* in man, comprising sixty direct passages during a period of three and a half years, had had any influence on the parasite, on the type of infection produced, or rendered it less effective in the treatment of general paralysis. A comparison of the infections comprising the first twenty passages with those of the last twenty passages has yielded data which indicate that the strain has undergone no change in pathogenicity or virulence or alteration in therapeutic properties during the direct passage from man to man through sixty generations. Again, the morphology of the parasite has not changed, and differs in no way from that found in naturally infected cases. Anopheline mosquitoes were successfully infected in the twelfth and fifteenth passages of the strain, but it is doubtful whether the parasite at this stage still retains the power to develop in the invertebrate intermediary host, as Gerstmann [3], in a recent publication, stresses the fact that after repeated passages from one human being to another the malarial parasite changes in such a way that it can no longer be infective to the mosquito, *Anopheles maculipennis*, or transmitted by them to man.

In conclusion, we should like again to acknowledge our indebtedness to Professors Stephens and Yorke, of Liverpool, for providing us with material to inoculate our early cases; to Dr. Clark, medical superintendent, for permission to publish these observations; and to Mr. A. H. Fann, senior laboratory assistant, for his kindly help and industry in the examinations of the blood.

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STUDIES IN VACCINIA VARIOLÆ.

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PART I.

A RAPID process of rendering calf lymph bacteria free was described by me in the *Journal of Pathology and Bacteriology*, vol. xxv, 1922, p. 176. The process consists in adding to four parts (by weight) of a glycerine-phenol stock mixture of the following composition—

Glycerine, pure, neutral	...			50·0	parts,	by weight
Phenol ...	...	...	...	0·5	,,	,,
NaCl ...	...	...	...	0·8	,,	,,
Distilled water	...	...		50·0	,,	,,

one part of recently collected calf pulp taken at the 120th hour following vaccination. The mixture is finely ground and placed in an open beaker furnished with a glass stirring rod. To it there is added 1 per cent. of a stock solution of 1 per cent. Brilliant Green in distilled water and the emulsion is immediately stirred. The blue-green coloration rapidly disappears, but shortly returns on continued stirring within about ten minutes when allowed to stand exposed to the air. Thereupon the highly-coloured lymph is distributed into a number of sterilized cylindrical tubes each provided with a closely-fitting cork stopper, which is protected from contact with the lymph by the intervention of a layer of gutta-percha tissue. The tubes should not be completely filled with emulsion, a small air-space being left to facilitate shaking of the contents in the second and last stage of treatment. From time to time aerobic and anaerobic cultivation tests are carried out as to the presence of organisms, the former on agar slopes and the latter by deep stabs in one per cent. glucose agar. The tubes are incubated for not less than three days at 37° C., followed by seven days at 18° C., before a negative opinion as to the presence of contaminating bacteria is arrived at.

As a rule the emulsion becomes bacteria-free at the end of fourteen days' storage at room temperature (approximately 60° F.), the fineness of the emulsion accelerating the bactericidal action. Thereupon the highly bactericidal, somewhat viricidal, and almost venomously tissue-toxic dyestuff is converted into (in these respects) the comparatively inert leuco body by means of the addition of sodium hydrosulphite in *minimal quantity*, when the original natural colour of the lymph becomes restored.

The colour change is one of reduction, the reaction being the conversion of Brilliant Green into colourless Leuco Brilliant Green with formation of acid sodium sulphite. The proportion of sodium hydrosulphite necessary to bring about this change is from 0·25 to 0·5 grm. per 100 c.c. of the emulsion. The white powder is directly added to the emulsion in the tube, from which the stopper is but momentarily withdrawn. The stoppered tube should then be inverted and the contents rolled, shaken and mixed for several minutes, when commencing decolorization is noted. The well-corked tube of emulsion should then be set aside to stand for fifteen minutes, when complete decolorization of the contents will be observed and the emulsion is then ready for distribution into capillary tubes as desired. Before the reducing salt is added care should be taken to shake off all deposit adhering to the bottom and side of the tube so that the coloured contents are thoroughly mixed and evenly distributed.

To prepare calf lymph free from bacteria at the expiration of five days only, double the proportion of dyestuffs is added to the emulsion (i.e., 1 50000) reduction to the leuco body by the addition of the reducing salt being effected at the appointed time.

Great care must be exercised to avoid the addition of the reducing salt in excess of that actually required to produce decolorization within fifteen minutes. Experience shows that the decomposition products of excess of this material is capable of acting as a powerful vaccinicide, so destroying the potency of the virus.

The genesis of this rapid method of preparation of calf vaccine lymph arose in connection with the epidemic of virulent small-pox which commenced in Scotland in the early days of 1920. The sources of the outbreak appear to have included both India and Egypt. The following record, taken from the official sources[1], best indicates the circumstances:—

"On April 24 all local authorities were circularized, attention being drawn to the serious nature of the outbreak and the precautions that should be taken with a view to every authority being prepared for eventualities being indicated. The desirability of a widespread vaccination movement and the need for an adequate supply of calf lymph then engaged our attention. Arrangements were made with the Government Lymph Establishment (at *Hendon*) and (as the margin available for use in Scotland without unduly trenching on the English reserve supply soon proved insufficient to meet the needs of Scotland) with approved private firms for the supply of calf lymph sufficient for the needs of the whole of Scotland. . . The issues of lymph rose to 20,000 doses per day, and at times the maximum attained 30,000. . . . During the year, since the beginning of the outbreak, 845,711 nominal doses were distributed (*i.e., through official sources*). It was ascertained that the sales through wholesale houses and retailers attained unprecedented proportions."

(N.B.—*Italicised words added for explanation.*)

It should be noted that at this period the reserve supply of calf lymph of the English Ministry of

[1] Second Annual Report of the Scottish Board of Health, 1920, p. 52.

Health at Hendon amounted to a total of two million doses only, and as by the method employed in its preparation several months' storage is required to eliminate its original bacterial contamination before it can be considered as fit for use, the policy adopted of asking the Scottish Board of Health to make its own arrangements for the lymph supply appeared, in the circumstances, eminently wise.

At an interview at the Scottish Board of Health in May, 1920, the writer was informed of the situation, namely, that the English Ministry of Health was unable to furnish a total of more than 30,000 doses, i.e., less than three days' requirements, and was asked to undertake to arrange for the delivery of lymph during the month of June, at the rate of 10,000 doses daily. This was carried out, the lymph being prepared by the rapid process.

During the year 1920, the writer was responsible, without laboratory assistance of any description, for the preparation of over a million doses of lymph, a considerable proportion of which was utilized in Scotland in connection with the epidemic of small-pox.

The preparation of the lymph by this method is not only rapid, but simple, and its supply to meet epidemic crisis requirements does not necessarily involve the additional employment of specially trained personnel.

No untoward results have been experienced in the use of the specially prepared bacteria-free calf lymph for vaccination by means of skin scarification in man or the rabbit, or in the case of corneal scarification in the rabbit only. Immunizing experiments in man, involving subcutaneous injection of the lymph, or in the rabbit subcutaneous or intraperitoneal injections, show certain disadvantages attending its use. In man, persistent focal swellings are frequently seen at this site of injection within a few hours following inoculation, even when only one or two drops of the considerably diluted lymph are administered. In hypersensitive cases, an intense spreading swelling with œdema may result within a few hours, attended by considerable pain lasting from one to two days.

Similarly, in the case of the rabbit, focal nodules form at the site of subcutaneous injection; with repeated intraperitoneal inoculation, which appears to be attended by the production of a high degree of vaccinal immunity coupled with the presence of specific protective substances in considerable quantity in the blood, wasting of the animal at length occurs, and frequently, on post-mortem examination, there is found a condition of plastic peritonitis with adherent coils of intestine. The intravenous injection of calf lymph in rabbits is frequently attended by hæmorrhages, embolism and sudden death, even when finely comminuted and considerably diluted lymph has been employed. These immediate undesired effects would appear to be due rather to the presence of the alien (calf) epithelial and other tissue, hitherto inevitably associated with the vaccine virus in the lymph.

Opportunity has now been afforded for the observation over prolonged periods of the longevity as well as the potency of the vaccine virus present in calf lymph rendered bacteria-free in accordance with this rapid process.

A yield of 57 grm. of pulp obtained from a bull-calf (No. 2113) on August 30, 1921, the result of vaccination 120 hours earlier by seed lymph obtained from a calf vaccinated nine months previously (i.e., in December, 1920), was converted into vaccine lymph in accordance with the method. For a period of two and a half years this lymph was tested at regular intervals upon rabbits, both by the skin and eye reactions, with unvarying positive results. At the termination of this period the remainder of the lymph was employed for immunization purposes. Bull-calf No. 2074 yielded 25 grm. of pulp on October 20, 1920, following vaccination 120 hours earlier by calf seed lymph prepared in January, 1920. This pulp was likewise converted into bacteria-free lymph by the method described. It has now been similarly tested at regular three-monthly intervals upon rabbits for a period exceeding five years. In April, 1925 (i.e. four and a half years following the date of collection and preparation) its potency appeared to be undiminished. In July, 1925, the skin reaction alone proved positive, the primary eye inoculation for the first time proving negative: the remaining eye, however, yielded a typical reaction when reinoculated on the fourth day from the skin eruption. In October, 1925, a similar result was experienced with a fresh rabbit. Subsequently a bull-calf (No. 251) was inoculated upon the skin direct from the original calf lymph, and yielded a typical eruption by the 120th hour. Another bull-calf (No. 252) inoculated from the eruption on calf No. 251 likewise yielded a typical eruption. Thus the longevity of the virus has exceeded five years and a high degree of potency has been maintained during the first four and a half years of that period. During the first four years of storage the temperature at which this lymph has been maintained has varied from 7° C. to 12·8° C., and during the fifth year the temperature has been maintained at 5° C. approximately.

It is therefore proved that in these conditions of storage the virus suffers no particular injury by reason of the special treatment adopted for rapid process of preparation of bacteria-free lymph.

Candle-filtration of Calf-vaccine-lymph: Negative Result.

Attempts to effect separation of the virus from the tissue by means of the centrifuge have invariably failed, as have all attempts hitherto made by means of filtration through baked candle-filters. Whenever a watery or glycerine-water emulsion of vaccine-lymph is centrifuged, the virus appears invariably to be associated with the deposit of epithelial tissue: if the supernatant fluid be rendered free from visible suspended matter, it is invariably found to be virus-free also.

During the past fifteen years I have made a number of attempts to separate the virus from various tissue-emulsions by means of slow filtration

under varying degrees of negative pressure through candle-filters of various makes and constitution. Those who have worked with glycerine-water emulsions will know how difficult this material is to filter, even with little matter in suspension. In general two types of candle have been employed, viz., those into which either kieselguhr (infusorial earth) or kaolin largely enter. Those known in England as the Berkefeld and the Pasteur-Chamberland are representative of each type. Finely ground emulsions in glycerin-water and ether-saline, both of calf vaccine pulp and rabbit testicular virus (the latter kindly furnished me by Dr. H. Noguchi, of the Rockefeller Institute), have been employed with practically the whole range of Chamberland laboratory filter tubes, L1 (coarse) to L13 (fine) and "F" bougie (porosity=L5), also the German Berkefeld "V" type, English Berkefeld No. 25, and in addition a range of kieselguhr filters made by other manufacturers in England. In not a single instance has a filtrate been obtained in which the presence of the virus could be proved by ordinary inoculation tests upon the rabbit.

This circumstance is particularly noteworthy, especially when it is borne in mind that some of the Chamberland types of filter-candle employed in the tests readily permit the passage of organisms, viz., peripneumonia, tetanus spores and others as large as the *Bacillus diphtheriæ*, whilst the "V" type of Berkefeld filter will permit the passage of such small organisms as *B. pneumosintes* 0·15 to 0·3 micron in length.

The method employed by the Paris Laboratory for the French inspection (Contrôle) of the Chamberland filters (système Pasteur) previous to their sale appears to be sufficiently practical considering the enormous variation not only in the texture or porosity (due to variation in baking) of the individual candle, but as between individual candles of the same batch—all presumably of the same texture and rate of filtration. When comparison is made of, say, an L1 filter of a batch made at one date with another filter of similar nomenclature made at a later date, variations in colour may also be noted. The filters are made from pastes of mixed earths assembled from various districts of France, and different workmen may be employed on each occasion. Thus it comes about that an L1 filter-candle may show, under a constant pressure of five metres of water, a rate of filtration three times as great as that of an L1 filter of another batch; both pass the test as L1 filters and are marketed as such. They are identical in size and shape. In any case only one filter out of ten is subjected to the test before sale. An additional test to which all candles are submitted is the passage of air under pressure. The candle is placed under water and its interior connected by a flexible tube to a drum of compressed air maintained at a pressure of 1 atmosphere. An escaping stream of visible air-bubbles at any point from the outer surface of the candle ensures its immediate condemnation. It is the compressed air test to which a filter-candle used in a laboratory should be subjected prior to each new experiment before the validity of the subsequent test can be accepted. (I have often visited a filter-candle factory—unconnected with any of the foregoing—in which it was admitted that not a single test of any description had been applied to any of their candles before sale during the past thirty years).

The following experiments serve to illustrate the complete failure to obtain a virus-active filtrate from a finely-ground, comminuted and diluted calf-vaccine-lymph by means of a sound kieselguhr candle-filter, under negative pressure.

Protocol.—Calf lymph A.3 (50 per cent. glycerine) 50 c.c. taken and diluted with an equal volume of normal saline, and passed through Thomson's vaccine churn. 15 c.c. of the resulting emulsion set aside as No. 1 control. The remainder centrifuged in a Sharple's machine and 20 c.c. of the supernatant turbid fluid poured off and allowed to stand, when a deposit formed. The supernatant fluid (portion set aside as No. 2 control) thereupon passed through a German Berkefeld candle, "V" type.

First portion of filtrate after two hours' filtration = 1 c.c. clear: pale lemon-yellow tint (No. 3).
Second portion of filtrate after two hours' filtration = 3 c.c. faint trace lemon colour: clear (No. 4).
Third portion of filtrate after two hours' filtration = 3 c.c. faint trace yellow colour: clear (No. 5).

Five young rabbits selected and each inoculated on left cornea and dorsum (neck). One square inch of skin scarified, with materials No. 1 to 5 respectively. Rabbits subsequently kept in separate hutches.

Results.—Controls Nos. 1 and 2 each positive on eye and skin. Nos. 3, 4 and 5, entirely negative.

In another experiment British Berkefeld candle No. 25 was employed, its length being three inches and internal diameter half-inch. 50 c.c. of ground vaccine lymph was twice passed through a triturating machine as used in the previous experiment. This resulted in the production of an even emulsion which separated out slightly on standing twenty-four hours. The material was then centrifuged in a Sharple's machine for two minutes, and the turbid supernatant fluid was filtered under a negative pressure of twenty-five inches of mercury. In ninety-five minutes 50 c.c. of filtrate was obtained.

Samples of the material were collected at various stages and finally twenty-three young rabbits were each inoculated upon the eye and skin as follows:—

1. Control lymph, one rabbit.
2. First grinding, one rabbit.
3. Second grinding, two rabbits.
4. (*a*) Supernatant fluid from Sharple's centrifuge, three rabbits. (*b*) Deposit from centrifuge, one rabbit.
5. (*a*) Resulting slime left on outer surface of candle upon completion of filtration, two rabbits. (*b*) Filtrate, thirteen rabbits employed.

Result: Each of the ten rabbits tested under experiments 1-5 (*a*) proved positive, both for eye and skin. All the thirteen rabbits tested under 5 (*b*)

proved entirely negative. Thus whatever the type of candle-filter employed, whether kieselguhr or porcelain, all filtrates have been found to be entirely virus-free, and neither centrifuge nor filtration appears to offer any solution to the problem of the separation of the vaccine virus from epithelial or other tissue.

Separation of the Virus in quantity from Epithelial and other Tissues.

(*a*) *Increased Yield of Raw Vaccine Pulp.*

During the past five years, in order to obtain ample yields of raw vaccine pulp from vaccinated calves and to curtail the time and to facilitate the operation of inoculation involved in extensive scarification of the ventral surface of the calf (thorax excluded) and the inner aspect of each thigh, I have used an instrument similar in construction to the ordinary mechanical drawing-pen with the addition of a finger-plate so constructed as to provide a guard to limit both the depth and width of the two parallel incisions, namely, two millimetres in each case. The sketch of the instrument shown is drawn to full size (fig. 1).

This simple instrument enables the operator, without hesitation or danger, boldly to rule at one stroke regular double scarification lines in the desired direction on the animal's shaved skin, independent of—yet following—the movements (twitching, heaving) of the animal's body, which acts as the support for the instrument. An extensive area is thus scarified within a few minutes; there is no possibility of the danger of gashing, with bleeding, as frequently occurs when an ordinary scalpel is used for this purpose. By the use of this instrument, while the area of scarification is more extensive (as desired) the animal is considerably less exhausted, by reason of the speed of the operation. With large yields, the animal is killed and bled at the farm slaughter-house before the pulp is collected by means of a Volkman's spoon, subsequent to the necessary washing of the vaccinated area, and in this way admixture of the pulp with blood is avoided, as might occur with a living animal. The regular double scarification lines have the effect of producing a pulp which readily peels off in strips.

The following are the satisfactory yields obtained recently by my assistant (without previous experience) who undertook the entire responsibility of scarification, inoculation, and subsequent collection of the pulp from ten animals.

Eight bull-calves (age 3 to 5 months): 80·5, 55·5, 6·7, 97·2, 70·5, 53·97 and 46·5 grm., respectively.

One cow-calf (age six months): 50·5 grm.

One small kid (male) age three months, weight 0 lb.: 12·3 grm.

The average yield therefore per calf by this method is 66·37 grm. as contrasted with 31·6 grm., the average obtained from 103 calves vaccinated in 1920-21 with an ordinary scalpel.

N.B.—One gramme of pulp emulsified with 4 c.c. watery-glycerine usually yields a quantity of lymph sufficient for 500 human vaccination doses.

(*b*) *Separation of the Virus by Wick-Syphonage.*

This process for the freeing of the vaccine virus from epithelial and other tissue is the outcome of some earlier experimental work in connection with the purification of water in the field which was initiated by the writer at Leeds in 1913-1914 on behalf of the Army School of Sanitation, Aldershot. One particular phase of that problem was to clarify water expeditiously, whilst avoiding the use of a filter or chemicals, or mechanism containing moving

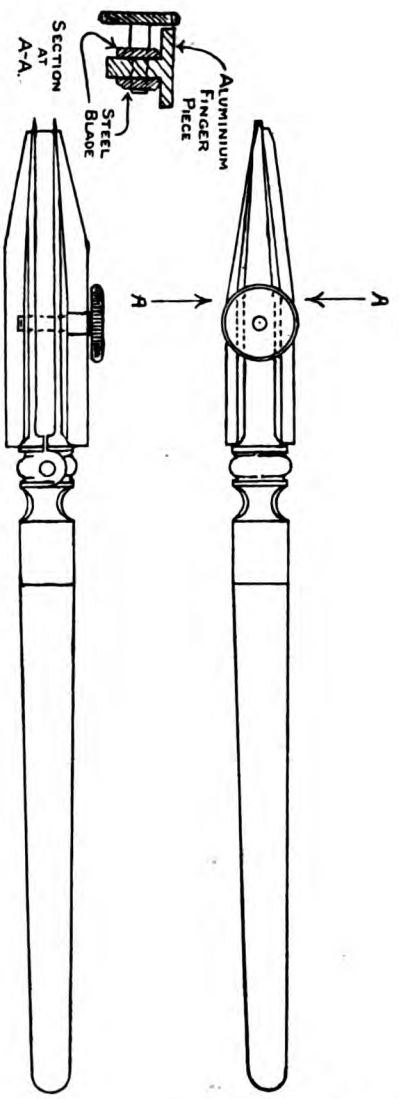


Fig. 1.—Double-bladed guarded scarifier. (Full size.)

parts. The principle of the method ultimately adopted by the writer, namely, wick-syphonage, has consistently yielded the desired results. It is based primarily upon the phenomenon, frequently observed, when a small pool of water is seen to be forming on the surface of the supporting table immediately underlying certain overhanging leaves contained in a bowl of flowers filled with water.

Overhanging moss (frequently), primrose, violet and many other leaves, may be culpable. Not all overhanging leaves give rise to the condition. Certain kinds of moss, when suitably placed, may be the means of the somewhat rapid discharge over the side of the bowl of the whole of the water contained in that vessel. It will usually be found that the water thus discharged is comparatively clear and free from plankton; it leaves little staining when the pool is removed. The physical phenomenon involved appears, in the first instance, to be one of simple capillary or surface attraction, the water rising and moistening one or both of the surfaces of the leaf which, if its free end overhangs the outside of the vessel to a level lower than that of the water contained within, thereupon commences to drip. Thus slow surface-syphonage is set up and maintained.

In the case of a mass of moss-fibres, surface capillarity means in effect the establishment of a number of minute continuous columns of water sheltered between the fibres, in addition to the simple moistening of the outer visible surface. If the whole mass overhang sufficiently, a double action occurs — central-syphonage and surface-syphonage—leading to frequent drip discharge of the contents of the vessel: this continues so long as the overhang reaches below the level of the water in the vessel. The "creeping" properties of mineral oils such as paraffin (kerosene) in wide and ever-spreading areas on certain surfaces, apparently irrespective of gravity, is a familiar phenomenon.

The whole of this phenomenon of surface-syphonage may be readily tested by means of filter-paper, or bibulous paper, cut into long, thin strips, each strip being supported by two long, fine wires threaded parallel through the paper to act as a support, and also to prevent collapse of the saturated paper when it is desired to make an artificial overhang. When a strip of paper hangs vertically so that its lower end is in contact with a liquid, the paper becomes moistened, the height to which the liquid rises depending upon the nature of the liquid. In a liquid placed in a watch-glass containing a mixture of several colloidal substances such as dyestuffs, it becomes possible at times to distinguish the several ingredients simply by the height to which the several components may rise. If it be a watery suspension, the watery component will often be found to rise to a height greater than that of any of the contained dyestuffs. If, when the maximal height has been attained to which the liquid will rise in the paper, the strip is bent over in the form of an overhang outside the watch-glass so that the extreme end of the moistened portion is depressed below the level of the liquid in the watch-glass, surface-syphonage is set up and the passage of the liquid onwards through the paper continues afresh. If the paper be torn off below the level of the liquid in the watch-glass, slow dripping takes place. If the experiment be carefully performed, it may be possible to separate the water from the colloidal matter, or even to separate colloidal substances from one another.

The action of filter-paper is not altogether mechanical, as is illustrated by the well-known experiment of placing a few drops of rosaniline hydrochloride upon a piece of flat filter-paper. The drop spreads, ultimately producing a clear, colourless peripheral zone which, on examination, is found to contain free hydrochloric acid; thus dissociation of the dyestuff has occurred. With surface-syphonage, therefore, it is not altogether a matter of the smallest sized particles or molecules in the fluid traversing the greatest distance; the nature of the wick or surface employed may exercise selective chemical or chemico-physical functions.

In the case of a wick similarly suspended and immersed, water rises throughout its substance, but, owing to imprisoned air, the rate of rise may be very slow. When the water has risen to a sufficient height in the wick to permit the adjustment of an overhang, dripping takes place from the free end. Columns of liquid have united within the fibres, and the action of flow and discharge from the free end of the wick is essentially the result of internal wick-syphonage. If, as a preliminary, the wick be plunged into boiling water, the contained air—a potential air-lock—is expelled and the wick immediately becomes thoroughly moistened. The wick may then be gently pressed to expel the excess of water. If the moistened wick be now arranged so that one end is immersed in liquid contained in a vessel, and the free end overhangs the outside of the vessel to a level below the level of the liquid contained within the vessel, wick-syphonage is immediately set up, and clear liquid shortly commences to discharge from the free end of the wick, the drip being maintained so long as the free end overhangs below the level of the water contained in the vessel. (This phenomenon is herein termed "wick-syphonage," in contradistinction to the ordinary rapid flow which takes place by syphonage through a closed tube.)

In connection with the experiments upon water purification, the crude water to be purified is poured into an ordinary vessel (No. 1) so as to reach a level within two inches of the upper margin, and an empty collecting bowl (No. 2) is placed at its side. A smaller graduated discarding vessel (No. 3) is also required, in order to receive the first portion of liquid to be collected and discarded when the volume passed over equals that originally retained in the moistened wick ("retention liquid"). A cleansed cotton or asbestos wick is selected, having a length *at least* twice the depth of vessel No. 1, and is made thoroughly wet by being plunged into boiling water. It may thereafter be suspended in the air, being held with forceps at one end in order to allow excess water to drip away from the lower or free end. The wick is then held by the middle, one half being submerged in the crude water, and the other half allowed to hang into the discarding vessel (No. 3). Shortly water free from turbidity slowly collects in the vessel until the graduated mark is reached, which indicates that the volume collected equals that originally imprisoned and retained by the wick after its withdrawal from boiling

water and the completion of the dripping of excess water, i.e., the original "retention liquid." The lower limb of the wick is then raised and transferred to the collecting bowl (No. 2), which slowly fills until at length the water stands in both vessels (Nos. 1 and 2) at the same level. If vessel No. 1 be raised, more water passes over. The rate of passage depends upon the size and looseness of texture of the wick, and also upon the number and material of the wicks employed. Wick-syphonage is always slower with an asbestos wick than with one made of cotton. All constrictions and sudden bends in the wick must be avoided, for these impede, and may arrest, the passage of the liquid. The wicks employed were cleansed by a preliminary immersion in ether, followed by a soaking in alcohol. Ultimately, when dried they were weighed, and again weighed after immersion in boiling water, followed by drainage of excess water. By this method the amount and volume of liquid finally retained or imprisoned in a wick of any particular length may be estimated. This is termed the "retention" figure, and the "discarding" vessel (No. 3) is graduated accordingly.

For uniformity in nomenclature, the following terms are employed in connection with wick-syphonage: The "wick-syphonate" is the liquid which is discharged from the lower end of the delivery or descending limb of the wick-syphon. The highest portion of the wick-syphon is the "summit"; the portion which lies between the summit and the floor of the vessel No. 1, containing the liquid to be purified, is the "collecting" or "ascending" limb; the "delivery" or "descending" limb is the portion which lies between the summit and the collecting vessel. The "submerged" portion of the wick is that which lies beneath the surface of the liquid to be purified; the "free" portion of the wick is that which lies outside this fluid. The "climb" is the vertical distance between the summit and the surface of the liquid to be purified in vessel No. 1. The "descent" or "fall" is the vertical distance between the summit of the wick and the surface of the liquid in the collecting vessel (No. 2). For experimental work, vessels Nos. 1 and 3 are so arranged that the lower or free end of the descending limb of the wick is at a level higher than that of the graduation mark for the latter. It is also advisable to arrange that the lower or free end of the delivery limb should terminate above the level of the liquid to be collected in vessel No. 2. In short, the end of the descending limb of the wick-syphon should always be free and terminate at a level above that of the fluid collected; it should not be allowed to dip into the syphonate.

Samples for examination to estimate the degree of purification may be collected at any moment from the dripping free end of the wick. In actual practice little adjustment is required if No. 1 vessel be tall and slender, and No. 2 be broad and low. A small hand-graduated beaker will serve as the "discarding" vessel No. 3 for collecting the first portion (retention fluid) of the syphonate to be rejected. The crude water to be selected for purification at Leeds was collected near the intake of the reservoir at Fewston. It is peaty in colour and contains asterionella, desmids, diatoms and siliceous particles, and is plentifully contaminated with bacteria. Slow passage through a single cotton wick yielded a clear, peaty-coloured fluid, in which all plankton and siliceous matter is absent; in general the bacterial content, as estimated by plating, was reduced by over 90 per cent., as compared with the raw water. With asbestos wicks, which permit only a very slow wick-syphonage, the syphonate is again clear, and contains less colouring matter; plankton and siliceous particles are absent, and the bacterial content is reduced by 97 per cent. As a rule, bacterial purification would seem to vary directly with the "climb," and inversely with the rate of flow. The submerged portion of a wick used for a considerable period will be found to become slime-coated, and even slime-choked, so impeding the rate of syphonage unless it be removed and cleansed. A simpler plan, however, is to change the wick. It was found that the slime-coating which appeared upon the surface of the submerged portion of the wick exercised a not unfavourable influence upon the quality of the syphonate; and in these respects, in so far as water purification is concerned, forms a very close parallel with the function exercised by the water-purifying slime-coat which forms in the superficial layers of a sand-filter-bed. The cotton wicks employed were 1 in. in diameter and $\frac{1}{8}$ in. thick, the weight being 21 grm. (approximately $\frac{3}{4}$ oz.) per yard. Two simple experiments show the capacity for purification of turbid fluids such as cow's milk, or china clay in watery emulsion, by means of wick-syphonage, the wicks employed being composed of asbestos (necessarily containing $2\frac{1}{2}$ per cent. cotton fibre in its substance as a supporting mesh), and pure cotton, respectively.

(1) *Kaolin emulsion in water.* — Exceedingly finely-ground and washed kaolin is shaken up with distilled water, in the proportion of 1 grm. per litre. After six hours standing, 200 c.c. of the supernatant turbid fluid is drawn off and set aside, and the remainder discarded.

(*a*) *Cotton-wick-syphon.*—100 c.c. passed through. Macroscopically: Syphonate appears clear, but, viewed through a depth of six inches, there is a faint opacity. Microscopically: Hanging-drop examination, no particles of kaolin seen.

(*b*) *Asbestos-wick-syphon.*—100 c.c. passed through. Macroscopically: Syphonate is bright and clear when viewed through a depth of six inches. Microscopically: Hanging-drop examination, no particles of kaolin seen. Syphonage action slow.

Thus, both asbestos and cotton wicks prevent the passage of particulate matter visible by direct microscopic examination; the asbestos wick prevented, in addition, the passage of particles of colloidal dimensions which cause the faint opacity.

(2) *Fresh cow's milk diluted* 1 *in* 10 *with normal*

saline.—This dilution is necessary to prevent choking of the wick by cream (fat) formation. 0·25 per cent. formalin added to prevent decomposition.

(*a*) *Cotton-wick-syphon*. — Macroscopically: Syphonate considerably clarified and somewhat opalescent. Microscopically: Syphonate contains only the smallest fat globules which are few in number. Fat globules of intermediate and large sizes, present in control, are entirely absent, as are all epithelial cells.

(*b*) *Asbestos-wick-syphon*. — Macroscopically: Syphonate shows a beautiful opalescence, and is semi-clear by transmitted light. Microscopically: Syphonate is free from all fat globules; epithelial cells entirely absent. Syphonage action is very slow.

The slime-coat which naturally forms on the upper layer of a water-purifying sand-filter exercises an essential function in arresting the passage of bacteria present in the traversing raw water. In the process of freeing the vaccine-virus from epithelial and other tissue by wick-syphonage (taking care always to avoid the use of asbestos-wick), a slime deposit always forms rapidly upon the upper and lower surfaces of the submerged portion of the wick, even when this passes obliquely through the lymph. Indeed, experience shows that a potent syphonate is more rapidly obtained when a very large surface of wick, thus plentifully slime-coated, is submerged, as occurs when the wick passes obliquely through the lymph in which it lies loosely coiled, without constrictions, free of the vessel wall, and resting on the bottom along its free edge only (i.e., preferably not flat). There is a distinct art in arranging the submerged portion of the wick to the best advantage. The slime-deposit, which consists of epithelial and other tissue containing the virus, is not intended to function as a bacteria-arrester. Indeed, the question of bacterial purification does not enter into the problem at all, for the lymph used in these experiments had all been previously rendered free from pathogenic organisms. It may be that the wick substance (cotton, worsted) by surface action dissociates the virus from the adherent slime-deposit, the liberated virus then being carried forward in the column of liquid slowly ascending the wick.

The sequence of events appears to be as follows: upon the setting up of wick-syphonage, there is a general draught of lymph from all directions towards the submerged wick and epithelial tissue rapidly deposits upon all exposed surfaces. The liquid slowly permeating through the slime epithelial deposit carries with it a considerable quantity of virus, and passing through the wick-syphon, is ultimately delivered into the collecting vessel. Here the liquid is seen to be free from epithelial tissue, clear or slightly opalescent, a small amount of colouring matter is present; vaccine virus is present in increasing concentration as the process continues. The first syphonate, consisting of the wick "retention fluid," must always be discarded. In the experiments for the freeing of the vaccine virus from calf lymph containing 50 per cent. glycerine, it was found that the establishment of maximal potency of the wick syphonate did not occur until after the wick had been functioning for one week, at least.

The apparatus adopted for prolonged wick syphonage (fig. 2) consists of a container or glass lipped beaker *A*, 2 in. in diameter, supported upon a special glass-holder *g*1, which rests on the floor of a crystallizing dish *B*, 3 in. in diameter which functions as the "collecting" vessel. *B* in turn is supported by a glass-holder, *g*2, resting upon the floor of beaker *C*, 4 to 4½ in. in diameter which acts as the "discarding" vessel. Beaker

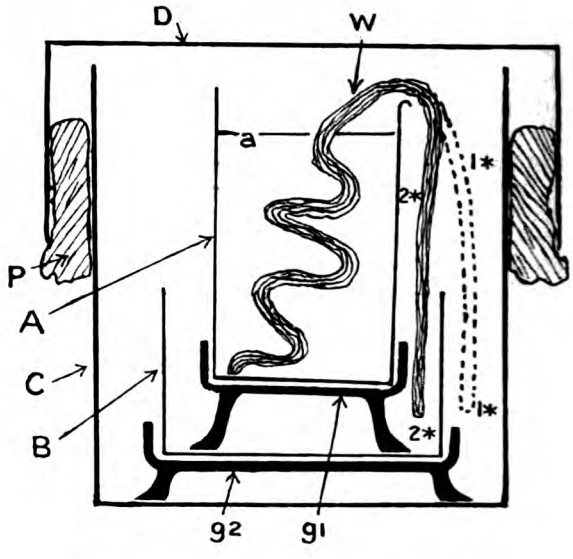


FIG. 2.—APPARATUS FOR WICK-SYPHONAGE.

A = vessel receiving lymph vaccine emulsion.
B = collecting vessel for wick-syphonate.
C = discarding vessel for wick retention-fluid.
D = cover. P = cotton-wool plug-collar. W = wick.
g^1, g^2 = quadruped glass supports for A and B, respectively.
W 1*—1* = position of wick delivering retention-fluid.
W 2*—2* = " " " " wick-syphonate.

C is capped by an inverted crystallizing dish *D* 5 in. in diameter. *P* is a circular string-fastened cotton-wool collar, which loosely plugs the interspace between *C* and *D*. The assembled apparatus is carefully sterilized, and when cooled 100 c.c. of the triturated vaccine, epithelial or tissue emulsion either in glycerine or saline-ether, is poured into *A* up to the level *a*, about 1½ in. below the level of the lip. A prepared 1-in. cotton wick, 7 to 8 ins. in length, the "retention figure" of which has been ascertained by previous trial, is then adjusted in the position W1*—1*, the lower free end of the descending limb terminating below the level of the floor of vessel *A*, and lying freely between the walls of *B* and *C*. Cover *D*, which in the meantime has been placed in an inverted position on a sterilized asbestos mat, is then lifted up and replaced in position over *C*.

Clear liquid shortly begins to drip from the lower free end of the wick and passes into discarding vessel *C*. The first portion to escape is that originally added to the wick in the process of moistening, and as soon as a quantity equal to the "retention figure" has accumulated in *C*, the liquid is again lifted, and the lower end of the wick is readjusted by means of sterile forceps, so as to occupy position W2*—2*, the terminal portion lying between *A* and *B*. Liquid now drips and passes into collecting vessel *B*, from which it is removed as required by means of a sterile pipette, the cover *D* being removed and replaced at each operation with the usual precautions.

During the process of wick-syphonage, the apparatus must be kept in a refrigerator at 5° C., although at this temperature the viscidity of the liquid is increased, and rate of syphonage is retarded. In the case of saline-ether emulsions (ether 10 per cent.), the apparatus, before transfer to the refrigerator, is placed in a slightly larger-sized receptacle, which can be readily rendered air-tight, in order to prevent subsequent evaporation and escape of the ether. (A tin-box with a well-fitting push-in lid is suitable for this purpose). It will be found that wick-syphonage, in the case of saline-ether emulsions, is somewhat rapid, but the syphonate yielded may be weak in virus-content in contrast with glycerinated syphonates, which, though slow in flow, are much more potent.

As soon as the liquid portion of the emulsion placed in *A* has been transferred by means of the wick to *B*, so leaving a soft slime or sediment upon the inside walls and floor of *A*, and upon all the previously submerged portions of the wick, a second extraction of virus from the slime residue may be carried out. For this purpose, the syphonate liquid in *B* is pipetted off, and the wick is carefully withdrawn with the aid of an assistant who, with two pairs of sterile forceps, holds the wick ends carefully apart. *A* is refilled (up to the level *a*) with a glycerine-water mixture (equal parts) or saline-ether (10 per cent. ether), in accordance with the previous constitution of the emulsion. With the aid of a glass rod—the end of which is flattened so as to function as a scraper—stirring then takes place, and the wick-syphon is carefully replaced in position W2*—2*. It is not necessary to remove the slime-deposit already formed upon the wick, and indeed this should not be done unless the wick has become slime-choked, and syphonage practically arrested. In this case, the slime-deposit should be scraped off the portion of the wick which has been submerged, and incorporated by being stirred with the contents of the emulsion in *A*, and a freshly-prepared wick is thereupon adjusted in position W1*—1*. The procedure thereafter is as already described with a primary wick-syphonage.

In order to ascertain the extent to which this extraction process may be profitably repeated, a quantity of glycerinated vaccine lymph (calf *A*1) was submitted to wick-syphonage for seven successive occasions, the experiment continuing over 203 days. The first four consecutive syphonates of the series gave typical reactions upon both sites, when 0·05 c.c. was inoculated upon the eyeball and shaved skin area at the nape of the neck of the rabbit. The fifth and sixth consecutive syphonates proved positive in the case of the skin only, the eye inoculations being entirely negative. With the seventh syphonate the reaction both to eye and skin inoculation proved negative.

At the termination of the experiment, portions of the pultaceous residue remaining on the wick in chamber *A* after the completion of the seventh extraction were inoculated both upon the eye and skin of a rabbit, with the result that the skin only proved positive, the eye being negative. This experiment was thereupon repeated upon a second rabbit, when the skin proved positive and the eye, after some delay, proved positive also. A portion of the untreated lymph set aside as a control was tested as to potency upon three occasions during the experiment, namely, at the beginning, in the middle, and again at the termination, and the results showed no appreciable loss of potency, either for eye or skin reactions. Incidentally, it may be noted that a portion of the first wick-syphonate inoculated upon the arm of an adult not vaccinated since infancy, gave typical vaccinia reactions, and six months later a calf inoculated upon the skin with the material also yielded typical vesicles by the fifth day following inoculation. Thus it will be seen that a considerable quantity of vaccine virus was obtained during the prolonged and repeated process of extraction of the epithelial tissue, although it has not been proved possible to liberate and abstract the whole of the virus content originally present.

To appreciate the significance of these results as bearing upon vaccinal potency, a "dilution-to-extinction" test was carried out upon a series of rabbits with potent wick-syphonate. For this purpose the left cornea of each animal was treated with 3 per cent. cocaine hydrochloride, and subsequently scarified and inoculated with 0·05 c.c. of the liquid; at the same time, an area of one square inch of the shaved nape of the neck of each animal was scarified and inoculated with a similar quantity. It should be noted that the area of the rabbit's cornea varies from 0·23 to 0·3 square inches.

The following are the results:—

		Rabbit number	Reaction: Cornea	Reaction: Skin
Control: undiluted wick-syphonate...		1	++++	++++
Diluted with 50 per cent. glycerine)	1 : 5	2	+++	+++
	1 : 25	3	+++	+++
	1 : 50	4	–	+++
	1 : 125	5	–	+++
	1 : 500	6	–	++
Diluted 1/1,000, 1/2,500, 1/5,000, 1/10,000 ...		7, 8, 9, 10	–	–

Thus a diminution of vaccinal potency is indicated by a delay in the onset of the typical eye-reaction, whilst the skin reaction remains typical. Further dilution leads to the abolition of the eye-reaction without impairment of the skin reaction. Still greater dilution leads to a limitation of the inten-

sity and extent of the skin reaction, and finally a stage arrives, with sufficient dilution, when both eye and skin reaction are entirely negative. The explanation may be that the actual immunity or resistance to the vaccine virus of the rabbit's corneal epithelium is greater than that of the skin, but the fact remains that the chances of a successful inoculation of the cornea may be diminished partly on account of the limited area involved, the area of the rabbit's cornea varying from 0·23 to 0·3 square inches, as compared with the area of inoculated skin (one square inch). Also there is the consideration that whereas by simple supervision the virus is allowed to dry upon the shaved skin at the nape of the neck (fortunately one of the few sites which is naturally beyond the reach of the animal's tongue), in the case of the eyeball not only is it impossible to attain drying of the virus contained in liquid vehicle, but much of the inoculation is laved off by the tear-secretion, coupled with the involuntary and constant movement of the eyelids over the corneal surface.

Whatever the explanation, it is a point of practical significance that progressive weakening of a vaccine virus in liquid vehicle is first indicated by a delay or disappearance in the corneal reaction of the rabbit, whilst the skin reaction remains apparently undiminished and unchanged.

By this method, progressive increase in the virus potency of a syphonate is likewise indicated. In the case of a viscid glycerinated calf lymph (*A*3) —a one-inch cotton-wick being employed, as before—the first 10 c.c. of colourless fluid was collected after forty-eight hours' syphonage, and was discarded as retention fluid; rabbit inoculations proved negative. The syphonate collected during the following six days was tinted, and repeated tests upon rabbits yielded typical skin-reactions, but in every instance the corneal reaction proved negative. Towards the termination of the first complete syphonage—six weeks later—when a total of 60 c.c. had passed over, liquid collected directly from the free end of the delivery limb of the syphon gave positive results upon both eyeball and skin of the rabbit. At this stage there was added to the residue of the lymph remaining in vessel *A*, a quantity of glycerine-water mixture, sufficient to make up the original volume, and the contents stirred, and the wick-syphon replaced. The subsequent syphonage, disregarding the first 10 c.c. passed over as representing the retention-fluid of the wick (although this retention-fluid was the residual undischarged portion of the first syphonate) immediately showed a maximal degree of virus potency.

With other glycerinated lymphs, the first 10 c.c. of the syphonate collected subsequent to the discharge of retention fluid has shown maximal potency within forty-eight hours. It will be noted that by using a single one-inch cotton-wick and filling the receiving vessel *A* with 100 c.c. of emulsion, a total of 25 c.c. may be syphoned over in ten days. During the first two or three days the daily rate of flow is 5 c.c., but subsequently the daily yield progressively diminishes, and towards the tenth day may be 1 or 2 c.c. only or even less. This is an indication that the wick is slime-choked and must be cleared of deposit or replaced by a fresh wick, if increased flow is desired. The composition of the glycerinated lymph used in these experiments is as follows: calf lymph pulp, 1 part; glycerine, 2½ parts; water, 1½ parts.

In the case of ether-saline emulsions, 1 part (by weight) of pulp is ground up with 3½ volumes of normal saline and ½ volume of ether is subsequently added. Wick-syphonage is comparatively rapid, the first 10 c.c. (colourless retention fluid) being delivered within two and a half hours. During the next twenty-four hours, a 30 c.c. tinted liquid was collected, and during the forty-eight-hour period following, 25 c.c. Thus the wick-syphon yielded a total of 55 c.c. in seventy-two hours. The potency of this rapidly syphoned material varies with individual pulps. In some cases the potency immediately attains the maximum of a potent glycerinated lymph syphonate, but more frequently it appears to be weaker, causing a typical eruption when inoculated in the rabbit on the skin only, the corneal surface remaining unaffected.

Variation in Wicks.

Increase of size and looseness of texture of the cotton-wick employed yielded a more rapid syphonate, and a similar result follows the employment simultaneously of a number of cotton-wicks. Plaited worsted wicks appear to function as efficiently as those made of cotton. Plaited silk wicks readily permit the passage of the virus by syphonage, but in the case of wicks made of asbestos fibre (containing 2½ per cent. cotton as a supporting substance) whilst slow syphonage is set up and a coloured fluid passes over resembling in appearance the syphonate delivered by a cotton-wick, upon inoculation tests being carried out with the rabbit the fluid is invariably found to be totally inert. Thus the asbestos material completely arrests the passage of vaccine virus in the syphonate.

(The exact composition of the fibre used in the manufacture of the asbestos wick employed in these experiments is apparently a trade secret. The wicks tested are those supplied to the writer at Leeds in 1913 by Messrs. Roberts, of Armley. Similar wicks are now manufactured from a mixture of short-fibre Canadian chrysotile-asbestos and Rhodesian asbestos the yarn containing from 2 to 10 per cent. cotton, as a basis.)

Protein as an Adjunct in the Treatment of Resistant Syphilis (Russell D. Herrold, M.D. *Journal of the American Medical Association*, February 6, 1926).—The injection of gonococcic protein intramuscularly in combination with neo-arsphenamin intravenously exerts a favourable influence on the reduction of the Wassermann reaction and on the clinical course, particularly the adenopathy. There is no deleterious action with the simultaneous use of the two methods of treatment.

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THE JOURNAL OF

Tropical Medicine and Hygiene

APRIL 15, 1926.

VAGINAL THRUSH.

INFLAMMATORY lesions of mucous membranes caused by infection with various fungi are included under the term "thrush," and may be met with in various situations, being differentially designated by the name of the situation in which the lesion is found. Infection of the oral mucosa in this way has been the longest known and most frequently studied, so that when the term "thrush" is used without any qualifying adjective this is the condition usually understood. Of the remaining mucous membranes, that of the vagina is the one most frequently so affected, and to this condition the term "vaginal thrush" is often applied. Infection of the various mucous membranes with the thrush micro-organisms is very common throughout the tropics, but it may also be met with in temperate and even in cold climates.

It is generally stated that thrush is due to the fungus *Oidium albicans* Robin. Recent researches, however, both in the tropics and in temperate climates, have shown that the ætiology of thrush is far from being so simple as this, and that not one fungus only, but a number of different fungi may act as the causal organism. These different fungi may readily be differentiated one from each other by the application of appropriate biochemical methods. Thrush, therefore, whether of the mouth, or of the vagina, or any other mucous membrane, is not merely a single affection, but comprises a group of conditions clinically very similar, but due to different micro-organisms.

A critical study of the organism to which thrush is usually ascribed and which was originally described as *Oidium albicans* by Robin in 1853, shows that it really belongs to the genus *Monilia;* its correct name is, therefore, *Monilia albicans* Robin. That a number of different fungi have been included under this designation is evidenced by the different characters which have been ascribed to it by different investigators. Thus some have affirmed, whilst others have denied, that the organism liquifies gelatine, coagulates milk, and so on.

The genus *Monilia* comprises a group of the Fungi Imperfecti, and the Fungi Imperfecti possess the following characters. In the lesions the vegetative body (thallus) is composed of mycelial threads of rather large size, often showing arthrospores and numerous free oval or roundish, budding, yeast-like forms. In cultures, especially on solid media, mostly roundish or oval budding elements are seen, whilst mycelial filaments are scanty or may be absent. By subculture in various vegetable extract liquid media, however, the formation of mycelial filaments may often be restored. The monilias, as a rule, ferment sugars and other carbohydrates with the production of gas. This fact may be made use of in the identification of the different species of monilia, and also forms the basis of Castellani and Taylor's mycological method for the recognition of the different carbohydrates and other carbon compounds.

The more important monilias, which have been found in vaginal thrush in cases occurring in the tropics, in the Balkans, in Italy, and in England, belonged to groups *balcanica*, *pinoyi*, *metalondinensis* and *tropicalis*, and more extended investigation is considered likely to reveal other members of the genus in this condition.

A search of the literature shows that cases of vaginal thrush and of vaginal monilia infection have not been very frequently recorded, and the condition would not seem to be so well known as the condition warrants. In the typical vaginal thrush a membranous vaginitis is present in which thrush-like patches of membrane are present on the mucosa in which monilias may be observed both on microscopic and on cultural examination.

Other forms of vaginal moniliasis also exist, in one of which the inflammation of the mucosa is of the purulent type, no thrush-like membranous patches being present, but the secretion is thick and purulent, and in the absence of bacteriological examination the condition may be mistaken for gonorrhœa. Further, pruritus of the vagina, of the vulva and of the anus also occurs which is due to monilia infections.

Further, a similar symptomatology may also be induced by other members of the group of Fungi Imperfecti, and up to date there has been found in the vaginal secretion of native women suffering from vaginitis, fungi of the genera *Oidium*, *Aspergillus*, *Sporotrichum*, *Cladosporium*, *Sterigmatocystis*, *Cryptococcus*, *Willia*, *Vibriothrix* and *Hemispora*, and further investigation will probably reveal many more.

As all these fungi and the infections to which they give rise are more abundantly present in the tropics, and can only be established by bacteriological examination, it behoves the tropical practitioner to bear this condition in mind and to have the necessary bacteriological investigations carried out. Not only would he probably soon find fresh forms of causative fungi, but the recognition of their presence would also indicate the correct treatment to be employed, since the great majority of these fungus infections yield more readily to the topical application of iodine than to any form of medication.

F. E. T.

Annotations.

The Relation of Albuminuria to Protein Requirement in Nephritis (J. P. Peters, and H. A. Bulger, *Archives of Internal Medicine*, February, 1926).—A study of the nitrogen metabolism of certain patients with acute and chronic parenchymatous nephritis has been made in an attempt to determine to what extent protein lost as albumin in the urine can be replaced by food protein. The total urinary nitrogen of these patients is not a satisfactory measure of nitrogen catabolism. The nitrogen catabolism can only be estimated from the urinary non-protein nitrogen after proper allowance has been made for changes in blood and tissue nonprotein nitrogen and variations of body weight due to diuresis or accumulation of œdema. By the administration of large amounts of carbohydrate and fat it has proved possible to reduce the protein catabolism to from 0·5 to 0·7 grm. per kg. per day. If enough protein is given to cover the nitrogen catabolism plus an additional amount equivalent to that lost as albumin in the urine nitrogen wastage may be prevented. Most of the patients when they enter the hospital show evidences of previous protein deficiency. If they are given more than enough protein to replace the amount lost in the urine they will store the excess within certain limits thus repairing the effects of previous nitrogen wastage. This protein wastage may be partly due to early dietary mismanagement. The loss of protein as albumin in the urine is certainly a serious contributory cause. It also seems probable that the disease itself, in its acute stages at least, is characterized by a higher protein metabolism than normal. Abnormally high blood-protein nitrogen has only been observed when the nitrogen catabolism was relatively high and has usually returned to the normal level as the clinical condition of the patient improved and the nitrogen catabolism diminished.

On the Occurrence of Paralysis after Treatment with Antirabic Vaccine (J. W. Cornwall and W. A. Beer, *Indian Journal of Medical Research*, January, 1926).—These studies show that fresh normal nerve substance is toxic to both rabbit and men when injected subcutaneously. The toxic dose varies widely with the individual, some showing paralysis after less than 20 mg. per kg. of body weight, others tolerating over 1 grm. per kg. without inconvenience. The action of phenol renders the nerve substance slightly less toxic. In antirabic treatment it is desirable to be able to increase the dose of the antigen. This could be done by separating the antigen from its toxic vehicle or by neutralizing the toxicity of the vehicle; the latter seems the more practicable alternative.

Pneumococcic and Streptococcic Peritonitis: Report of Twenty-three Cases in Infancy and Childhood (B. Lipshutz and H. Lowenburg, *Journal of the American Medical Association*, January 9, 1926).—Pneumococcic and streptococcic peritonitis is a comparatively frequent abdominal lesion in infancy and early childhood. The majority of these cases occurred in children under two years of age. Fifty per cent. were preceded by a definite pharyngeal infection or coryza, the latter antedating the onset of the abdominal symptom by from four to seven days. The clinical picture is characteristic. Differentiation of the streptococcic from the pneumococcic type can be made only by means of smears or a culture of the exudate. The peritonitis always begins as a pelvic peritonitis. An early operation is recommended to prevent any error in diagnosis and to give an outlet for the peritoneal exudate. All supplementary measures directed toward overcoming the profound sepsis that sooner or later dominates the clinical picture, have been without avail.

Original Communications.

STUDIES IN VACCINIA VARIOLÆ.

By Myer Coplans, D.S.O., O.B.E., M.D.
From the Laboratory, Model Farm, Hendon.

(*Continued from p.* 130.)

Part II.

(1) Properties of the Liberated Vaccine Virus.

(A) *Centrifuging.*—A series of saline-ether and glycerinated syphonates has been subjected to prolonged centrifuging in order to obtain some evidence as to the physical configuration of the virus. 4-in. glass tubes were selected and each filled to a depth of 3 in. with selected syphonate. The tubes were carried in buckets which swing at a radius of 6 in. The speed of the centrifuge was variously estimated at 1,500 to 2,000 (nominal 2,000) revolutions per minute, and centrifuging was carried out at maximal speed continuously for four hours. Subsequently, corresponding with each centrifuged syphonate, three rabbits were inoculated on eyeball and skin as follows: (*a*) Control, not centrifuged. (*b*) Supernatant fluid: 0·05 c.c. taken from uppermost layer of centrifuged liquid in tube. (*c*) 0·05 c.c. taken from lowermost layer.

There was a general agreement as to the results, save that the onset of the symptoms in the case of centrifuged material derived from the supernatant layers was in every instance slightly delayed as compared with the control.

Assuming this correspondence of results to be within the limits of variation in reactions experienced amongst rabbits when a series is inoculated with the same virus, it may be stated that the virus-content of the liquid is but very slightly diminished as the result of centrifugal force. No grounds have been afforded by this experiment for speculation as to the physical condition of the virus.

(B) *Filtration.*—The entirely negative results obtained by filtration of glycerinated calf lymph through porcelain and kieselguhr filter-candles have already been referred to. An additional series of filtration tests under negative pressure with potent saline-ether and glycerinated wick-syphonates has been carried out with Chamberland filter-candles of type "L2" and the German Berkefeld "V." The former permits the passage of large organisms, and the latter, the *Bacillus pneumosintes*. In the case of saline-ether emulsions, 5 c.c. passed through both "L 2" and "V" filters in a few seconds. In the case of glycerinated syphonates, with a negative pressure of 28 in. of mercury, filtration took place at the rate of 1 c.c. per hour in the case of the porcelain filter, and at the rate of ½ c.c. per hour with the kieselguhr filter. In each and every instance the filtrate proved entirely negative when inoculated upon the eyeball and skin of a series of rabbits. The liberated virus appears to be incapable of passing a sound filter which has been found to permit the passage of organisms as large as the *Bacillus diphtheriæ*. It should be noted in this connection that the "L2" filter was employed in these experiments only after a preliminary trial had shown that it was impossible to employ an "L1" filter for the filtration of glycerine-syphonates, the glycerinated liquid failing altogether to pass this filter even after prolonged negative pressure lasting one hour.

(C) *Experiments with Mineral Earths and Wood Charcoal* [4].—It is obvious from the foregoing experiments that the non-passage of the virus through the candle-filters must be due to other than simple mechanical causes. In order to investigate the matter further, fresh unused "L2" and "V" candle-filters were obtained and pulverized in an "end-runner" mill, mechanically driven at 100 revolutions per minute for half an hour. The fine powders were then added severally in varying proportion to glycerinated and saline ether wick-syphonates, of known potency, placed in stoppered tubes. The tubes were hand-shaken for a few minutes and set aside in the refrigerator to deposit for several days, the shaking being repeated at intervals. At the end of this period, the tubes were gently centrifuged and a series of rabbits were inoculated with the deposits and supernatant fluids respectively.

A fresh rabbit was used for each examination, a particular deposit being inoculated upon the eye and the neck of the same rabbit, this animal being used for no other experiment: similarly with a supernatant fluid.

The results are as follows:—

I. Added: 10 per cent. "V" Berkefeld Candle-Filter (kieselguhr) pulverized.

(1) *Wick-Syphonate from Glycerinated Lymph* (*Calf A* 4).

(*a*) Supernatant fluid: Rabbit No. 81. Eye and skin both negative.

(*b*) Deposit: Rabbit No. 82. Eye and skin both negative.

(2) *Wick-Syphonate from Saline-ether Lymph* (*Calf* 251).

(*a*) Supernatant fluid: Rabbit No. 77. Eye and skin both negative.

(*b*) Deposit: Rabbit No. 78. Eye and skin both negative.

II. Added: 33 per cent. L2 Chamberland Candle-Filter (porcelain) pulverized.

(1) *Wick-Syphonate from Glycerinated Lymph* (*Calf A* 4).

(*a*) Supernatant fluid: Rabbit No. 90. Eye negative, skin ++.

(*b*) Deposit: Rabbit No. 89. Eye ++++, skin ++++.

(Result (b) confirmed with rabbits 91, 91B, 91C and 110B).

(2) *Wick-Syphonate Saline-ether Lymph* (*Calf* 251).

(*a*) Supernatant fluid: Rabbit No. 92. Eye and skin negative.

(*b*) Deposit: Rabbit No. 91. Eye ++++, skin ++++.

III. The following are control tests on the untreated wick-syphonate.

(1) *Undiluted Wick-Syphonate Saline-ether Lymph* (*Calf* 251).

Tested on eye and skin of rabbits Nos. 58, 71, 75, 103B and 104B: Skin ++++, eye negative.

(2) *Wick-Syphonate from Glycerinated Lymph* (*Calf A* 4).

Tested on eye and skin of rabbits Nos. 1B–10B:

Undiluted	Skin ++++	Eye ++++
Dilution 1/5, 1/25	,, +++	,, +++
,, 1/50, 1/125 ...	,, +++	,, negative
,, 1/500	,, ++	,, ,,
,, 1/1,000, 1/2,500	,, negative	,, ,,
,, 1/5,000, 1/10,000		

The several activities of the powders obtained from the pulverized "L2" and "V" filters were further investigated, and inasmuch as these filters are composed, respectively, largely of kaolin and kieselguhr which have been subjected to fierce furnace heat (calcination) for prolonged periods, each syphonate has been treated with raw kaolin and also with kaolin which had been subjected to heat in an open porcelain dish over a Bunsen flame in the laboratory (i.e., partly calcined kaolin, not vitrefied): similarly with raw kieselguhr and with this material likewise heated for a short period in the laboratory (i.e., partly calcined kieselguhr).

The results are as follows: In the case of raw kieselguhr added to the two syphonates there is no appreciable effect: the supernatant liquid appears to be unaltered as to potency. The deposit shows no evidence of having become activated by the virus. In short, raw kieselguhr functions as an inert substance in the presence of vaccine virus. In the case of partly calcined (laboratory-heated) kieselguhr, the result of admixture with the two syphonates is closely comparable with that obtained by the pulverized Chamberland "L2" candle-filter. The virus is found to be completely removed from the saline-ether wick-syphonate when the supernatant fluid is tested both on the eye and skin of rabbits, and the activity of the deposit is likewise correspondingly increased, so that it now yields complete reactions both on the eye and skin of the inoculated animals, whereas the untreated syphonate, whilst affecting the skin, does not affect the inoculated eye of a rabbit. Similarly with glycerinated syphonate, which contains a very high virus-content, there is also marked diminution in potency of the supernatant fluid, coupled with corresponding increase of virus (vaccinal) activity of the deposit.

The action of the pulverized Berkefeld "V" (kieselguhr) candle-filter upon the virus contained in both potent wick-syphonates derived from the glycerinated lymph A4 and the saline-ether lymph 251, *is to render the liquid completely inert: the deposited powder is also completely inactive.*

The action of the pulverized Chamberland "L2" *(porcelain) candle-filter* upon the two potent wick-syphonates *is*, in the case of the glycerinated syphonate, *to remove over 98 per cent. of the virus from the liquid, the deposit being exceedingly active*: in the case of the saline-ether syphonate, the liquid is rendered completely inactive while the deposit is found to be of an increased potency, and affects not only the skin, but also the eye of the rabbit. Thus the powder possesses two separate functions: it causes the disappearance of the virus from the liquid, and at the same time the deposited powder has gained a virulence corresponding with the quantity of virus which has disappeared from the liquid. *The "L2" candle-filter has become sensitized by the virus removed from the filtering liquid. The action of the kieselguhr candle-filter is to render the virus in the filtering liquid entirely inert.*

Raw kieselguhr powder therefore appears to be without effect upon the virus; partially calcined kieselguhr powder (laboratory-heated) removes the virus from the liquid and the deposit becomes correspondingly sensitized; completely calcined kieselguhr powder (furnace-heated) causes the liquid to become completely inert, the deposit being also completely inert. To use a chemico-physical expression, the raw kieselguhr is inert, partially calcined kieselguhr adsorbs the virus and becomes correspondingly active. The explanation of the action of the calcined kieselguhr may be similar, in that the virus is also adsorbed from the liquid, but is so completely bound to the surface of the particles of the powder as to prove inert when inoculated upon the eye and skin of a sensitive animal such as the rabbit.

From these experiments two means are indicated not only for removing the vaccine from the wick-syphonate, but also of concentrating the virus in higher potency upon the surface of the powders employed, namely (1) the material obtained by pulverizing the "L2" Chamberland filter, and (2) partly calcined kieselguhr.

Raw and partially calcined (laboratory-heated) kaolin—the latter not being allowed to vitrefy—acting upon the potent glycerinated wick-syphonate, are severally found to resemble that of the pulverized Chamberland "L2" porcelain filter-candle. The supernatant fluid is entirely inactive, whilst the deposit is correspondingly exceedingly active. These deposits, after removal of the supernatant fluid, have been found to retain their potency for over six months. (Still under observation.) The virus activated deposits obtained from the glycerinated wick-syphonate have been subjected to further treatment by (*a*) repeated washing with normal saline followed by centrifugation, or (*b*) 50 per cent. water-glycerine mixture, likewise followed by centrifugation. This process has in each case been consecutively repeated for six occasions, so that any supernatant fluid originally moistening the particles of the deposit has been diluted to over one millionth part of the original amount. The result of this process has been that, in each case there has been no loss of virus activity exhibited by the deposit when inoculated upon rabbits in accordance with the normal procedure. No question, therefore, arises that the supernatant fluid may possibly harbour any accessory factor necessary for the virus to exercise full activity. The whole of the virus appears to be attached to the surface of the particles of raw kaolin, and the method of washing is an additional process for purifying the deposit from contaminating matter.

The action of asbestos powder upon the potent glycerinated wick-syphonate is comparable with that of kaolin, the supernatant fluid becoming inert and the deposit correspondingly active, the activity persisting for several months.

It has already been shown (above) that the wick-syphonate passed by an asbestos wick is complete inert as to vaccinal potency.

Meerschaum powder, both raw and partially

calcined, has been similarly tested, the results resembling those obtained with kaolin.

Wood charcoal ("Norit" brand, obtained from brazilnut shell) has also been similarly tested. There is, at times, a difficulty in sedimenting this material, especially when mixed with glycerinated wick-syphonate, and in such cases centrifuging does not materially help deposition. There is considerably less difficulty with the saline-ether wick-syphonate, and the supernatant fluid, when completely free of particles of charcoal, is found to be inactive, whereas the sediment is correspondingly active.

Thus a variety of materials present themselves for removing the vaccine virus from the wick-syphonate, namely, wood charcoal, certain raw mineral earths, and some of the latter baked or ired (calcined) in varying degree.

From these experiments, means are clearly indicated not only of removing the vaccine virus from a weakly potent wick-syphonate, but also of concentrating the virus in higher potency upon the surface of the powders specially employed, and in this connection the material obtained by pulverizing the Chamberland L2 filter and also partially calcined (laboratory-baked) kiesulguhr powder have proved particularly successful.

(D.) *Immunization Experiments upon the Rabbit.*—(1) *Intravenous Inoculation.* To each of a series of fourteen young rabbits there was administered intravenously, viâ the ear marginal vein, wick-syphonates obtained from glycerinated calf lymph (A4), in the proportion of 2 c.c. per kilo body weight, the syphonate having been diluted before administration with normal saline in the proportion of one part of syphonate to four parts of saline. Only one dose was administered to each rabbit. At the same time, areas of the external surface of both ears, nape of the neck, shoulders, haunch, and abdomen, were shaved. On the fourth or fifth day following, a fine, papular rash developed more or less profusely on both surfaces of each ear, and reached the maximum on the ninth or tenth day, when the papules, having increased in size, became umbilicated. In some cases umbilication was earlier. From the eleventh to the thirteenth day, the papules became dry and peeled off in the scabs. About the fourth or fifth day, occasional discrete papules of larger size, about two to three millimetres in diameter, each surrounded by a zone of erythema, developed upon the shaved area of the skin of the neck, shoulder, or haunch. No papules were observed upon the abdominal surface. The papules upon the body, shortly after their appearance, also became rapidly vesicular, umbilicated, then pustular, and becoming dried, the scabs separated from the ninth to the twelfth day. The body eruption was typical in appearance, and, as confirmation, rabbits inoculated upon the neck and eye with material derived from the vesicles developed typical lesions. Material from these lesions was passed by inoculation through a series of three animals, whereupon each in turn developed typical vaccinal lesions, both upon the eye and skin.

Observations upon the rectal temperature of all the animals which received the intravenous dose showed, with two exceptions, that upon the fourth and fifth day there was a rise of temperature of from 1° to 4° F., which fell within the following two or three days to normal limits. With the two exceptions there was no rise of temperature.

(2) *Intraperitoneal Inoculation.*—Two additional animals each received intraperitoneal injections of diluted wick-syphonate, the dose administered being similar to that employed for the intravenous tests. No rash or rise of temperature was subsequently observed in either case.

During the period of thirty-one days, at varying intervals from the twelfth day onwards, all the animals treated intravenously or intraperitoneally were once inoculated upon the eye and skin with potent glycerinated calf lymph. In no instance was a positive skin reaction observed. Both the animals treated intraperitoneally developed eye lesions only, whilst three out of the fourteen rabbits treated intravenously developed eye lesions only, the skin reaction proving entirely negative in the fourteen animals.

Thus it is shown that whilst the whole of the treated animals proved refractory to inoculation by skin scarification upon the body, five of the animals were sensitive to the infection by means of inoculation upon the scarified cornea.

The fourteen animals of the series subjected to preliminary vaccination by intravenous inoculation were at various intervals (up to the 213th day) subsequently revaccinated with potent calf lymph, and in some instances the revaccination has been four times repeated. With every revaccination, both eye and skin were inoculated save in one instance in which the skin reaction only was tested. (This exception was on the 181st day on the occasion of the fourth revaccination of rabbit No. 19B, when, as before, the skin reaction proved negative.)

The second revaccination of ten surviving animals which proved to be negative to both eye and skin reactions at the first revaccination, took place at intervals varying from 40 to 120 days after the intravenous inoculation. Two rabbits proved positive to both eye and skin, five were positive to the eye only; three animals proved entirely negative.

The third revaccination of the three animals found negative at the second vaccination took place at intervals of 100 to 171 days following the intravenous injection; all three again proved entirely negative.

The fourth revaccination of these three animals took place at an interval of 174-213 days. Two of these revaccinated for the fourth occasion upon the 174th and 180th day, respectively, proved entirely negative. The third proved on the 213th day to be positive to the eye only, the skin reaction proving entirely negative. This animal had previously been vaccinated for the third time on the 171st day, with entirely negative results.

Control tests with the selected calf lymph were

repeated during this period upon normal rabbits, both upon the eye and skin, and in all the cases the resulting reactions were typically positive.

For the purpose of comparison as to the degree of immunity developed as the result of primary inoculation (vaccination) by means of scarification of the skin and cornea, a series of eight young rabbits was inoculated each upon the eye and skin with potent glycerinated calf lymph, with the result that typical lesions developed both upon the eye and skin in each animal. Thereupon, during the period of thirty days following, at varying intervals from the twelfth day onwards, the eight animals were reinoculated with the same calf lymph upon the skin and upon the cornea of the eye previously unvaccinated. The results were as follows: In four of the animals, typical lesions developed upon both the eye and skin; in three animals the reaction was positive in the case of the eye only, the skin proving negative. One animal only of the series proved entirely refractory both to the skin and eye inoculation. It will be seen that, upon revaccination of these animals, in no case did the skin reaction prove positive whilst at the same time the eye reaction remained negative.

Comparison is therefore afforded for testing the degree of immunity produced in rabbits by the intravenous method of inoculation by means of wick-syphonate with that obtained by the process of skin and eye scarification with calf lymph; the superiority of the former method during the period under review is striking. It should be noted that throughout these immunity tests the use of lymph derived from virus obtained from rabbits has been strictly avoided; only calf vaccine lymph has been employed. In the process of revaccination it has also been usual to avoid revaccinating an area of skin which has been inoculated in previous tests, and in addition the eyeball revaccinated has been the fellow to that inoculated upon the previous occasion. In no instance in these tests has an eyeball which yielded a positive result upon a previous occasion been revaccinated; such tests are invalidated inasmuch as it is known that with the eyeball, as with the skin, a local reaction may give rise to an immunity strictly localized to the reacting area.

Table I affords facilities for making a ready comparison of the several immunities established by the superficial, intravenous, and intraperitoneal methods of primary inoculation (vaccination).

It will be seen that of a total of fifty-two revaccinations carried out upon twenty-four rabbits, upon twenty-six occasions the eye and skin reactions were both negative; on six occasions only were the skin and eye reactions both positive; on nineteen occasions the eye reaction alone was positive, the skin reaction proving negative. *Upon no occasion was the eye reaction negative when the skin reaction proved positive.* Thus if the eye reactions be disregarded and attention be paid to the skin reactions only—vide columns (5), (6) and (8)—upon six occasions only would these animals have been found positive, whilst upon the remaining forty-six occasions they would have been deemed negative.

Table II illustrates the severity of the eye an skin symptoms observed upon revaccination animals in which the primary inoculation (vac cination) was performed by means of vaccinat of the eye and skin of each animal with glycerinate calf lymph.

Table III applies similarly to those animals which the primary inoculation (vaccination) w performed by the method of intraperitoneal intravenous injection of the wick-syphonate obtain from glycerinated calf lymph.

Tables II and III (upon which Table I is base shew that in not a single instance did the eye r action remain negative when the skin reacti proved positive, whilst in six animals in which bo the eye and skin reactions had proved negati upon previous tests, the first onset of returni sensitiveness was manifested by the positive reacti of the eyeball only.

Reference has already been made above to t necessity of employing a lymph of sufficient va cinal potency in order to produce a typical reacti on the rabbit's eyeball, yet in the case of t rabbit's skin the same lymph, diluted many time continues to produce typical reactions, althou the diluted material proves innocuous when inoc lated upon the eye. The explanation may be o of higher natural immunity of the corneal epith lium as compared with the skin, or it may be d to mechanical difficulties of obtaining a satisfacto inoculation.

Therefore, if in the case of an animal in which co plete protection both to the skin and eye reactio has become established by immunization, there a return of sensitiveness manifested by the *eye reaction alone*, it is obvious that the insusceptibil to vaccination by skin scarification alone is criterion of the susceptibility of the animal gen rally to the action of the virus when the path infection takes place otherwise than by the ski

If it be a fact that the eyeball is normally mo resistent than the skin to artificial infection- in any case it is more difficult to vaccina the eyeball—it follows that the returni sensitiveness of the eye to vaccination wh the general vaccinal protection is passing off whil the skin still remains insensitive is positive evidenc of supersensitiveness of the eyeball, and possibl of the body generally, towards infection by t virus.

(2) *Production of Immune Sera.*—(A) *Calves.* T sera of those animals from which large yields vaccine pulp were obtained (previously referred t have been tested as to their capacity to prote rabbits against vaccination by the skin and e by means of potent calf lymph

Calf A1. Red ♂, aged six months, yielde 80·5 grm. of vaccine pulp at 120th hour. Sla tered thirteenth day. Yield 1,300 c.c. seru (0·4 per cent. ether added).

(*a*) *Neutralizing tests in vitro*: 1 vol. of ser was added, respectively to 4, 2, 1 and ½ vols glycerinated calf lymph of full potency, and t several mixtures were warmed at 37° C. for h

TABLE I.

Immunity: Revaccination in the rabbit with calf lymph, illustrating frequency of eye and skin reactions.

Preparation (primary inoculation)	All revaccinations with calf lymph	Eye Reaction			Skin Reaction		Eye: not tested. Skin: neg.	Eye: pos. Skin: pos.	Eye: pos. Skin: neg.	Eye: neg. Skin: pos.	Eye: neg. Skin: neg.
		Not tested	Pos.	Neg.	Pos.	Neg.					
Series A. 8 *Rabbits.* Primary vaccination of both eye and skin with calf lymph	*A* 1. *First Revaccination.* Interval after preparation: 12—30 days	0	7	1	4	4	0	4	3	0	1
Series B. 2 *Rabbits.* Intraperitoneal injection (2 c.c. per kilo) of wick-syphonate ex calf lymph A 1	*B* 1. *First Revaccination.* Interval after preparation: 12—31 days	0	2	0	0	2	0	0	2	0	0
Series C. 14 *Rabbits.* Intravenous injection (2 c.c. per kilo) of wick-syphonate ex calf lymph C 1	*C* 1. *First Revaccination.* Interval after preparation: 12—30 days. 14 rabbits	0	3	11	0	14	0	0	3	0	11
	C 2. *Second Revaccination.* Interval after preparation: 40—120 days. 13 rabbits	0	9	4	2	11	0	2	7	0	4
	C 3. *Third Revaccination.* Interval after preparation: 100—153 days. 9 rabbits	0	3	6	0	9	0	0	3	0	6
	C 4. *Fourth Revaccination.* Interval after preparation: 174—213 days. 6 rabbits	1	1	4	0	6	1	0	1	0	4
	C total. 42 revaccinations. Interval 12—213 days ...	1	16	25	2	40	1	2	14	0	25
Series A, B and C. Total: 24 rabbits	A, B and C. Total: 52 revaccinations	1	25	26	6	46	1	6	19	0	26

TABLE II (SEE TABLE I, SERIES A).

Shews severity of lesions in the rabbit upon revaccination following primary vaccination with glycerinated calf lymph. The term "interval (days)" denotes the period elapsing since the primary vaccination took place.

Rabbit No.	34	16	35	33D.	48	51	33C.	33B.
Interval (days)	12	13	16	20	20	24	25	30
Lesions: Eye	+++	+++	+++	+++	+	+	+++	−
Skin	+++	−	++	+	−	−	+	−

TABLE III (SEE TABLE I, SERIES B AND C).

Indicates severity of lesions in the rabbit upon repeated revaccination with glycerinated calf lymph following primary inoculation (vaccination) by means of intraperitoneal or intravenous injection with wick-syphonate obtained from glycerinated calf lymph. The term "interval (days)" denotes the period elapsing since the primary inoculation took place.

Rabbit No.	Inoculation	Revaccination Interval (days)	Eye	Skin	Second revaccination Interval (days)	Eye	Skin	Third revaccination Interval (days)	Eye	Skin	Fourth revaccination Interval (days)	Eye	Skin
9	Intraperitoneal	31	+++	−									
10	,,	21	++	−	33	−	−						
20	Intravenous	12	+	−	90	+	−						
19	,,	16	+++	−	90	+++	−	153	+	−			
11	,,	20	−	−	74	−	−	100	−	−	174	−	−
19B	,,	20	−	−	45	+++	−	121	++	−	181	(Not tested)	−
24	,,	20	−	−	120	+	+						
28	,,	20	−	−									
12	,,	25	−	−	84	−	−	171	−	−	213	++	−
20B	,,	25	−	−	45	++	−	121	+++	−			
25	,,	25	−	−	120	+++	++						
27	,,	25	−	−	120	+++	−						
26	,,	30	−	−	40	++	−	118	−	−	180	−	−
29	,,	30	−	−	40	+++	−	114	−	−	180	−	−
30	,,	30	−	−	40	−	−	121	−	−	182	−	−
31	,,	30	+++	−	40	−	−	121	−	−			

ADDENDUM.—(*Not referred to in text, nor included in Table I.*) Fifth revaccination. Interval: 366 days.

Rabbit No. 11. Eye + + + + (intense reaction), skin + + (crusts separated on ninth day).
,, ,, 12. Eye + + + (severe reaction), skin + (crusts separated on seventh day).

an hour. With each mixture, a rabbit was inoculated upon the eye and skin, and all four rabbits proved entirely negative.

(*b*) *Tests in vivo*: Six rabbits were each given serum subcutaneously or intraperitoneally, the quantity varying from 1 to 15 c.c. per kilo. At the same time each animal was vaccinated upon the eye and skin with calf lymph.

Results as follows:—

Rabbit No.	Dose per kilo c.c.	Eye	Skin
Control test 1	0	++++	++++
,, ,, 2	1	++++	++++
,, ,, 3	2½	++++	+++
,, ,, 4	5	+++	+++
,, ,, 5	7½	+++	–
,, ,, 6	10	+++	–
,, ,, 7	15	+++	–

A further quantity of serum was treated by one-third saturation with ammonium sulphate and the precipitated euglobin redissolved in normal saline was made up to the original volume of serum. Three rabbits were treated similarly to rabbits Nos. (5) (6) and (7) above, each receiving as a protective dose 7½, 10, and 15 c.c. per kilo body weight, respectively. Upon vaccination, the lesions produced resembled those of rabbits Nos. (5), (6) and (7).

Calf A3. Yield: 55·5 grm. vaccine pulp. Animal slaughtered fourteenth day. Three rabbits given respectively 5, 10, and 15 c.c. serum per kilo body weight, and each vaccinated at the same time. Both eye and skin lesions developed in all three cases. The skin lesions in the rabbit receiving the largest protective dose were slight.

Calf A4. Yield 46·7 grm. vaccine pulp. Slaughtered fourteenth day. Rabbit given 15 c.c. serum per kilo body weight and vaccinated. Result: eye lesion fully developed; skin lesion negative.

Calf B2. Yield 49 grm. vaccine pulp. Serum obtained twenty-second day. Rabbit tested as for Calf A4, with similar result. Serum obtained forty-ninth day: no protective effect—thus resembling serum of unvaccinated calf.

Calf B1. 97·2 grm. vaccine pulp. Slaughtered fourteenth day. Three rabbits treated with 5, 10, and 15 c.c. serum respectively, per kilo body weight. Result: protective dose: 5 c.c., eye + + + skin negative. Protective dose 10 c.c. and 15 c.c., eye +, skin reaction doubtful. Serum was administered to a rabbit (15 c.c. per kilo body weight) twenty-four hours before vaccination, with the result that the eye reaction was considerably delayed and proved only slight, the skin reaction being entirely negative. Serum administered in large quantities up to a period of twenty-four hours subsequent to vaccination appeared only to delay the onset of the eye symptoms, which ultimately proved typical, as were those of the skin.

Serum administered to rabbits after twenty-four hours following vaccination appeared to be without protective effect. (N.B.—Serum from calves A3, A4, B2 and B1 given subcutaneously.)

Four full-grown rabbits fed daily for four days in succession with 20 c.c. of serum were each inoculated upon the second day. In three animals typical lesions developed unchecked, both upon the eye and skin; the fourth animal proved completely refractory.

These experiments show that a certain degree of protection against vaccinia is capable of being exercised in rabbits by the administration of serum drawn from calves which have been the subject of an extensive skin eruption; the quantity of serum necessary seems, however, too great for practical purposes.

(B) *Goats* Nos. 1 and 2.—Serum collected on the 5th and 42nd days, respectively, subsequent to extensive scarification, showed no protective action against vaccinia when administered subcutaneously to rabbits in doses of 15 c.c. per kilo body weight.

(C) *Rabbits*.—A series of rabbits has been treated by repeated intraperitoneal injections of potent bacteria-free calf-lymph, the total amount of lymph administered in each case varying from 5 c.c. to 25 c.c.; the period over which the immunizing inoculations were spread varied from fourteen days to three months. The rabbit serum upon examination *in vitro* was found to be capable of neutralizing in each case four times its own volume of potent calf lymph, when the mixture was warmed at 37° C. for half an hour. The rabbit serum, upon subcutaneous administration to rabbits, was proved to have a far higher protective value against subsequent vaccination with calf lymph than the serum obtained from extensively scarified calves. In so far as the eye reaction is concerned, this was prevented by the administration of immune rabbit serum, 1 c.c. per kilo body weight only being given, but in these cases the skin reaction proved positive.

It would almost appear necessary, if it be desired to abolish both eye and skin reactions in the rabbit to administer the mixed sera of immunized calves and rabbits.

It is interesting to note that when a mixture of heated immune rabbit serum mixed with an equal volume of calf lymph and warmed at 37° C. for half an hour was tested upon the eye and skin of a rabbit, delayed eye symptoms occurred, the skin reaction proving negative. This experiment was repeated with a mixture of two volumes of lymph to one volume of serum, when both eye and skin reactions were completely negative. The test was again performed, using four volumes of lymph with one volume of serum, with the result that skin lesions developed, the eye proving negative. (The temperature of the heated serum had been raised to 50° C. for one hour, on three successive days.)

On repeating the three experiments with the same serum unheated, all three animals proved entirely negative to both skin and eye reactions. The phenomenon noted in which the eye reaction proved positive only in the presence of a mixture of vaccine virus and excess of neutralizing immune serum approximates to that already described by Neisser-Wechsberg [5] with other neutralizing mixtures in which the immune serum appears to be in excess.

SUMMARY.

(1) Calf vaccine lymph rendered bacteria-free ithin a few days by the Leuco-Brilliant Green rocess has been found to retain its potency for veral years. This method is specially applicable the rapid purification of lymph to meet epidemic quirements.

(2) An instrument designed for the purpose of pid and extensive vaccination of calves is described. This consists of a double-bladed scarifier ith a finger-plate so adjusted as to provide a ard to limit the depth and width of the two rallel incisions.

(3) A method is described for the liberation of ccine virus from epithelial tissue by means of ick-syphonage. Rabbits inoculated intravenously ith the liberated virus develop generalized vaccinia. he liberated virus is proved to be a non-filter sser. The action of filter-candles in completely esting the passage of the virus has been investigated, and also the behaviour of the virus in e presence of certain mineral earths and wood harcoal.

(4) The phenomenon seen in previously immunized rabbits of returning sensitiveness of the orneal epithelium to vaccine inoculation whilst e skin remains refractory is described and discussed. Does it indicate a negative phase in the abbit and the waning of protection against variola this animal?

(5) Experimental results are stated as to the otection afforded to rabbits against vaccinia by eatment with sera obtained from immunized alves, goats and rabbits.

Acknowledgment is made of the services of my ssistant, Miss E. G. Wilkinson, in connection with his research during the past two years.

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Morphologic Variations in a Ringworm Species n the Toes (Fred. D. Weidman, M.D., *Archives f Dermatology and Syphilology*, March, 1926).—ollowing the implantation of a non-pathogenic east directly on a ringworm lesion of the toes, a ingworm species, the primary culture of which had ad a constant morphology for three years, suddenly hanged from the downy to the powdery type. his variability means that we just expand our conception of the extent to which variation may occur n identical ringworm species as they come directly rom the lesions and make due allowance therefore n the determination of species. This applies particularly to members of the *Trichophyton gypseum* roup.

Abstract.

ON THE CARBON TETRACHLORIDE TREATMENT OF ANKYLOSTOMIASIS, WITH A NOTE ON THE HOOKWORMS OF PENANG.[1]

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WHILE on a tour of inspection, in 1923, Dr. A. L. Hoops, Principal Civil Medical Officer, Straits Settlements, requested the writer to undertake the treatment of a series of ankylostomiasis cases with carbon tetrachloride. Oleum chenopodii had been extensively employed in the District Hospital, Penang, by Dr. J. C. Tull, and as the carbon tetrachloride series would be carried out in the same hospital, and under similar conditions, it was thought that the investigations should yield valuable information regarding the comparative efficiency and toxicity of these drugs. So much has, however, been published on the efficiency of carbon tetrachloride during the past two years, that it is not intended to stress that part of the investigation, but rather to record the toxic manifestations noted, and to examine the biometrics of the hookworms of Penang.

In 1923, the pharmacology of carbon tetrachloride had not been thoroughly investigated. From its close chemical relationship to chloroform it appeared that fatty infiltration of the organs would probably result from its exhibition, and extensive fatty change in the liver had been recorded in a few human and canine cases. This condition already exists when there is advanced anæmia, and it was, therefore, decided only to include in the series cases with hæmoglobin exceeding 30 per cent.

On admission to hospital, the stools of all patients were examined by the film method, and the hookworm cases were passed to a special ward for treatment whenever no other serious disease existed. Treatment included a saline purge at night, followed by 2·5 c.c. of carbon tetrachloride on the following morning. One hour later this dose was repeated, and after an interval of two hours a second saline purge was administered. The worms were collected by washing and sent in formol saline to the laboratory, where they were counted and identified. Pressure on the hospital beds unfortunately precluded routine repeat treatment, and the flotation method was employed for determining any residual infection, seven days after the exhibition of the anthelmintic. The series comprised 155 cases. Of these, twelve absconded or were discharged at their own request before observation was completed.

INTENSITY OF INFESTATION AND HÆMOGLOBIN.

In Table I the cases are grouped according to the intensity of infestation, and the average percentage

[1] Abstracted from the *Trans. of the Roy. Soc. of Trop. Med. and Hygiene*, January 21, 1926.

TABLE I.—SHOWING THE INTENSITY OF INFESTATION AND HÆMOGLOBIN.

Number o hookworms	Less than 25	26 to 50	51 to 100	101 to 150	151 to 200	201 to 250
Number of cases (total 138) ...	101	21	9	2	2	3
Percentage of cases	73·3	15·2	6·5	1·4	1·4	2·2
Average percentage of hæmoglobin ...	61	59	55	55	30	42
Theoretical loss of hæmoglobin caused by hookworm infection ...	2	6	11	19	27	35
Average percentage of hæmoglobin plus theoretical loss through hookworm infection	63	65	66	74	57	77

of hæmoglobin is included for each group. In the *Report of the Commission for the Relief and Control of Hookworm Disease in Australia and Dependencies*, it is claimed that, on the average, a reduction of 10 per cent. in hæmoglobin is caused by 65 hookworms. Based on this factor a *theoretical* loss of hæmoglobin due to the average number of hookworms has been introduced into Table I, but the resultant figures indicate that no such simple relationship exists in the present series. Mhaskar (1924) was also unable to establish any definite connection between the intensity of infection and the fall in hæmoglobin. It appears, rather, that the human host is largely capable of compensating for the anæmia-producing factor until the number of hookworms approaches 150, but with more massive infections a rapid fall in hæmoglobin occurs. Many of the coolies were, however, also suffering from chronic malaria, and the average physical condition reflected the then existing economic situation, which was the sequel of the post-war rubber slump.

About 5,000 patients are admitted annually to the District Hospital, and of these some 12 per cent. were found to harbour hookworms. Three-quarters of the cases in the present series were infected with less than twenty-five worms, so that in not more than 3 per cent. of admissions was this intensity of infection exceeded. Only 0·6 per cent. were found to harbour more than 100 hookworms. A portion of the cases came from the town area, in which the pail system for night-soil collection is in vogue, but the majority were from outlying villages and coconut and rubber plantations. Areas of high infection do exist, particularly in some of the kampongs (villages) and on a few estates, but if only 3 per cent. of a typical population show a higher infection than 25 worms it must be conceded that the disease is not a serious one in the locality, and that the situation compares favourably with that in other tropical areas.

THE EFFICIENCY OF CARBON TETRACHLORIDE.

The criterion for discharge was a negative flotation test for ova, seven days after treatment. In five of 138 cases ova were demonstrated after treatment, and in one case two worms were found at autopsy. It may be suggested that the oviparous powers of the female worms were adversely affected by the anthelmintic, thus accounting for the high percentage of " cures " obtained, but Sweet (1924) has shown that any such effect of carbon tetrachloride has passed by the seventh day. It is not claimed, however, that the drug caused the expulsion of all hookworms in the remaining 133 cases. Soper (1924) found that, after a negative flotation test, repeat treatment is frequently followed by the expulsion of a number of worms, but the percentage of " cures " (96) is comparable with the percentage (84) obtained by Tull (1923) with oleum chenopodii.

Particulars of the hookworms from the five cases which were positive after treatment are embodied in Table II. The percentage expelled following the first treatment was 84, and the figures confirm the observations of others that *Necator americanus* is more easily dislodged than *Ankylostoma duodenale*.

TABLE II.—FAILURES WITH CARBON TETRACHLORIDE.

Case	Nationality	Treatment	Hookworms Expelled							
			Total	*Ankylostoma duodenale*			*Necator americanus*			
				Male	Female	Total	Male	Female	Total
1 ...	Tamil ...	First	156	15 ...	26 ...	41 ...	53 ...	62 ...	115
		Second	34	6 ...	14 ...	20 ...	11 ...	3 ...	14
		Third	11	0 ...	3 ...	3 ...	5 ...	3 ...	8
2 ...	Chinese ...	First	6	1 ...	2 ...	3 ...	1 ...	2 ...	3
		Second	2	1 ...	0 ...	1 ...	1 ...	0 ...	1
3 ...	Tamil ...	First	50	5 ...	11 ...	16 ...	18 ...	16 ...	34
		Second	2	0 ...	1 ...	1 ...	0 ...	1 ...	1
4 ...	Chinese ...	First	39	7 ...	9 ...	16 ...	9 ...	14 ...	23
		Second	4	1 ...	3 ...	4 ...	0 ...	0 ...	0
5 ...	Chinese ...	First	52	8 ...	15 ...	23 ...	13 ...	16 ...	29
		Second	7	1 ...	3 ...	4 ...	2 ...	1 ...	3
Total (all treatments)			363	45 ...	87 ...	132 ...	113 ...	118 ...	231
Total second and third treatment only ...			60	9 ..	24 ...	33 ..	19 ...	8 ...	27
Percentage remaining after first treatment			16	20 ...	28 ...	23 ...	17 .	7 ...	12

he results from this small number of cases also ıggest that the male necator may be more resistant treatment by carbon tetrachloride than the male, and the female ankylostome than the male.

Post-mortem Findings.

Five of the 143 cases died in hospital at intervals ter treatment of 44 days (amœbic dysentery); 25 ıys (pulmonary tuberculosis); 26 days (chronic terstitial nephritis); 24 days (bacillary dysentery); ıd three days (carcinoma). An assumption should ɔt be hastily arrived at that carbon tetrachloride prone to cause an acute exacerbation of the chronic ysenteric condition which is frequently seen in the siatic coolie. There is no doubt that the drug ıuses some intestinal irritation, but only in two of 43 cases did dysenteric symptoms supervene, and ı both there was an interval of three days between reatment and the appearance of any quantity of ıucus in the stools.

The first, second, third and fifth cases came to utopsy, and, although the numbers of hookworms xpelled after treatment had been 176, 19, 28 and 0 respectively, worms were found in the fifth only, he number being four. Macroscopic examination ınd histological sections of liver and kidney in the irst, second and third revealed no lesion referable o the anthelmintic. The fifth was a case of carcinoma in an elderly Tamil patient. The condition was not diagnosed ante-mortem, for no abdominal tumour was palpable and the liver was unenlarged. At the autopsy, however, the liver substance was found extensively invaded by carcinomatous deposits. Histologically the growth was found to be secondary to an intestinal cancer, although a prolonged search at the post-mortem examination had failed to localize the primary growth. The histological picture of the liver included a generalized fatty infiltration. Around secondary deposits in the liver a zone of fatty change is frequently seen, but in this instance the infiltration appeared to involve the whole hepatic parenchyma. The change is thought to be due to the action of the carbon tetrachloride, though no necrosis of liver cells was seen, and sections of the kidney showed some interstitial fibrosis but no change attributable to the drug.

The Toxic Manifestations of Carbon Tetrachloride.

The drug was subjected to chemical tests for impurities before administration was permitted. About 30 per cent. of the cases complained of such symptoms as nausea and vomiting, thirst, or a burning sensation in the epigastric region. Some 20 per cent. experienced giddiness, and in a few instances a transient nephritis, evidenced by hyaline casts, occurred. In one case a temporary albuminuria developed.

Since the completion of the above series, the writer has observed marked toxic symptoms in three additional cases, particulars of which are given below:—

Case 1.—A European, aged 52, with no clinical evidence of hepatic insufficiency, and a reliable non-alcoholic history, was given 4 c.c. of carbon tetrachloride followed by a saline purge. The bowels acted vigorously on the following day, the patient became slightly jaundiced, the icterus deepening during the three succeeding days. Diarrhœa was profuse, and the motions contained a quantity of mucus. The stools were examined on three occasions, but were negative for *Entamœba histolytica* and the dysentery group of bacilli. The patient became so weak that he was unable to walk to and from his bed, and the condition of the heart gave rise to anxiety. The urine contained bile; and albumin, which had been absent before treatment, appeared in quantity. Convalescence was very prolonged and normal vigour was not regained for upwards of two months. With the lead acetate, sodium hydroxide, and alcohol test recommended by Dr. Andrew Balfour, a definite darkening occurred with this specimen of carbon tetrachloride. A sample was returned to the manufacturers, who reported that, although a trace of carbon disulphide was present, the quantity was within the recommended limits.

Case 2.—A Malay woman, aged 35, was given 3 c.c. of carbon tetrachloride followed by a saline purge. Three days later the writer was again asked to see her. She had had nausea and intermittent vomiting since taking the drug. Giddiness and deafness were also complained of, and the sclerotics were slightly yellow. There had been no movement of the bowels for four days. Following a brisk purge many hookworms and ascaris were expelled, after which the symptoms rapidly subsided. The batch of carbon tetrachloride was found to be pure, and the symptoms were doubtless caused by the absorption of the drug in some quantity from the alimentary canal.

Case 3.—The inclusion of this case is due to the courtesy of Dr. J. G. Reed, who has investigated the value of confined carbon tetrachloride and oleum chenopodii in mixed hookworm and ascaris infections. He submitted to the writer material obtained at an autopsy, and also supplied the clinical notes of the case. The patient was a Tamil child, aged two years, who was admitted to hospital with signs of a massive infection. Hookworm and ascaris ova were present in large numbers, and the urine contained a trace of albumin. She was given ol. chenopodii 2 minims, and a number of round hookworms were expelled. Six days later carbon tetrachloride, 10 minims; ol. chenopodii, 4 minims; and ol. ricini 100 minims were given. The following day the œdema of feet was less marked, but weakness increased and death occurred thirty-six hours after the taking of the mixture. Histologically the liver showed massive fatty infiltration and some round-cell infiltration, but no central necrosis. Such fatty change is not infrequently seen in the livers of young children, and a few small areas of cellular infiltration are not uncommon in the tropics. The kidney showed extensive pathological changes. The glome-

rular epithelium was swollen and the capillary tufts dilated. The tubules contained a number of casts, and degenerative changes were present in the tubal epithelium. Collections of small round cells occurred throughout the organ. Albumin had been present in the urine before treatment, but the glomerular changes were probably due to the anthelmintic. This specimen of carbon tetrachloride was found to be pure.

Like all vermifuges, carbon tetrachloride is not without danger to the host, and its administration is frequently followed by sequelæ of a toxic nature. Such symptoms are rarely serious, and are to some extent paralleled by the sequelæ of oleum chenopodii, which is a less effective and more expensive anthelmintic in ankylostomiasis. In the opinion of the writer, carbon tetrachloride for medicinal use should be absolutely pure, and, even then, is contra-indicated in case of marked anæmia, alcoholism, hepatic insufficiency, chronic bowel diseases, and advanced renal cases, though Leach, Haughwout and Ash (1923) have found that it could be exhibited without anxiety to patients with a mild degree of renal disturbance. Case No. 2 indicates the necessity for bowel action within a short time of taking the drug, and patients should be instructed to report if no movement occurs within twelve hours. Under certain conditions the administration of carbon tetrachloride is fraught with danger, and it should not be prescribed until a careful clinical examination has been made.

Hookworm Biometrics in Penang.

The hookworm fauna of Malaya has been investigated in Fort Swettenham, Kuala Lumpur, and Singapore by Darling, Barber and Hacker (1920). New arrivals from China were then found to harbour 33·8 per cent. of ankylostomes and 66·2 per cent. of necators. In another group of Chinese, some of whom had been resident in the country for twenty years, the ankylostomes had increased to 38·4 per cent. Incoming Indians had 97·1 per cent. of necators and only 2·9 per cent. of ankylostomes. After residence in the country the latter percentage increased to 5·1. In the Federated Malay States there is little intermingling between Chinese and Indians, and hence each race tends to keep its own hookworm index, but Penang has a large fixed population and more mixing of the races occurs.

The cases of the present series are grouped in Table III, according to nationality and length of residence. The ratio of *A. duodenale to N. americanus* is found to be much higher in Indians of short local residence than would be expected. The tabulated results also show a marked increase in the ankylostome/necator ratio with length of residence for both Chinese and Tamils, and after ten years in Penang the hookworm indices of the two races approximate.

Chinese and Northern Indians are known to have a high ankylostome/necator ratio, but in Tamils the proportion of ankylostomes is usually low. In Penang 65 per cent. of the population is Chinese, and of these some 38 per cent. are born locally. It thus appears that immigrants to Penang gradually acquire the high ankylostome index which is characteristic of the Chinese.

The sex ratio (males to females) for *A. duodenale* was 1 : 1·61 and 1 : 1·54 in Tamils and Chinese respectively, and 1 : 1·23 and 1 : 1·17 respectively for *N. americanus*. *A. ceylanicum* was obtained from one patient, a Tamil who had resided for 25 years in Penang, and who also harboured *N. americanus*.

TABLE III.

Nationality	Length of residence in Malaya	Number of cases	*Ankylostoma duodenale* Group Total	*Ankylostoma duodenale* Ratio M/F	*Necator americanus* Group Total	*Necator americanus* Ratio M/F	Ratio *A. duodenale*/ *N. americanus*	Total hookworms for group	Average hookworms per case
Indians	Less than 5 years	42	431	1:1·6	905	1:1·2	1:2·1	1,336	31·8
	5 to 10 years	14	222	1:1·5	343	1:1·3	1:1·55	565	40·4
	Over 10 years	7	95	1:1·4	101	1:1·2	1:1·07	196	28·0
Total		63	748	1:1·55	1,349	1:1·23	1:1·67	2,097	33·3
Chinese	Less than 5 years	27	113	1:1·6	294	1:1·2	1:2·6	407	15·1
	5 to 10 years	20	122	1:1·3	155	1:1·2	1:1·27	277	13·8
	Over 10 years	28	275	1:1·6	277	1:1·1	1:1·0	552	19·7
Total		75	510	1:1·54	726	1:1·17	1:1·42	1,236	16·5

Current Literature.

Annales de la Societe Belge de Medicine Tropicale.

June, 1925.

Investigations on Alastrim in the Belgian Congo (L. Van Hoof).—Alastrim has been considered by some authors to be indistinguishable from small-pox or varicella. These investigations have shown it to be quite a distinct disease. The author has come into contact with the three infections at Stanley Pool for many years, and clinical facts differentiate them one from the other. Jennerian vaccination was of no value in the last epidemic of alastrim at Stanley Pool; on the other hand cow-pox is frequently inoculable to people cured of alastrim. Cow-pox does not immunize the monkey against the inoculation of alastrim, and alastrim does not immunize the monkey against the inoculation of the vaccine. The allergic virus taken from the monkey causes in man early

actions which are less intense than those of the imal, and are not followed by phenomena of neralization. The prophylactic measures against astrim are isolation, disinfection, and although nnerian vaccine has not always proved efficaous, it should not be abandoned. The clinical gns are not generally sufficient for the diagnosis alastrim and small-pox, and the two affections ay exist simultaneously, and the vaccination ould consist of a mixture of vaccine and specific mph against alastrim.

A Case of Asymmetrical Juxta-articular Nodosity a European in the Belgian Congo (R. Bernard d A. Broden).—The patient, a married man, ed 32, had been in the tropics for nine years, ring which time he was quite healthy, with very w attacks of malaria. Nothing to be noted in s family history. The infection began at the ginning of his fifth year in the Belgian Congo d continued for nearly five years before he prented himself for treatment in 1923. The case clearly not of syphilitic origin, it is possibly a se of yaws, but the diagnosis is very indefinite.

Stovarsol or "Acido Acetylxylaminophenylarsinic" the Treatment of Human Trypanosomiasis (F. an den Branden).—This product, which has been ported by many authors to have such a good fect in the treatment of syphilis, has not proved s efficacy in the treatment of yaws and human ypanosomiasis in the Congo. Natives can take rge doses for several consecutive days, but ovarsol has only a slow and short trypanocidal ction.

A Case of Intestinal Bilharziasis due to Schistoma hæmatobium (L. Dupuy).—Intestinal bilarziasis is very frequently met with in Katanga. t is often found in association with some other arasitic or intestinal infection. Of nineteen cases xamined, eighteen were of *Schistosomum mansoni* nd only one of *S. hæmatobium*, which is the first ported in Katanga. The patient was suffering om amœbic dysentery, which was cured in five ays by injections of emetine. On the sixth day umerous eggs of *S. hæmatobium* were found in e stools. The usual treatment was administered nd the patient cured.

Contribution to the Clinical Study and Treatment f Yaws (L. Dupuy).—Yaws is a common disease etween North and North-East Rhodesia, especially the villages near the River Luapula and its tribuaries. It is known under the name "Bonono." uring the author's three years' stay in these parts 55 natives presented themselves for treatment. he clinical aspect of yaws is described in detail. he secondary lesions are very variable, and are asily diagnosed. Tertiary lesions, however, lead o errors of diagnosis and are often confounded ith syphilis. Tertiary arthritis is a mono-articular anifestation of a clinical type and quite different rom tertiary sclerosis of yaws; it is soon cured f treated in the early stage. Large doses of N.A.B. should be used, the minimum being 04 eg. per kilo of weight. In tertiary lesions novarsenical and iodine treatment should be prescribed.

The Treatment of Animal Trypanosomiasis with "205 Bayer" (R. Van Saceghem).—These experiments have not given such good results as were expected. The sterilization of the peripheric circulation brought about by the injections was of very short duration. Large doses, 15 grm. to 100 kilos weight, prove fatal for bovidæ; at autopsy lesions of the liver, intestine and kidney are found, and the blood is not coagulated. "205 Bayer" is more active against *Trypanosoma congolense* than against *T. vivax*. This product is very much inferior to emetin.

Annotations.

The Rate of Loss of Hookworms in the Absence of Re-infections (A. C. Chandler, *Indian Journal of Medical Research*, January, 1926).—The following is the summary given by the author: Opinions differ widely as to the rapidity with which hookworm infections are reduced and lost in the absence of re-infections. Most of the published evidence indicates that the percentage of infection slowly decreases for several years, the drop being more rapid after five or six years, although cases of infection persisting for at least fifteen years in the apparent absence of re-infection have been recorded. Having found that reliable estimates of the degree of infection in groups can be obtained by means of estimation of eggs per gramme of fæces, egg-counts were made on 915 prisoners in the Alipore Central Jail for various periods of time under conditions which made the probability of re-infection very slight, if not completely absent. This investigation disclosed the fact that about 50 per cent. of the original infection is lost within three months, 60 per cent. in six months, 70 per cent. in one year, 80 per cent. in two years, 90 per cent. in four years, 93 per cent. in six years and 95 per cent. in eight years. Some slight infections were found, however, up to twenty years after imprisonment, but the possibility of *some* infection having occurred some time during this period cannot be excluded. This rate of reduction in egg output corresponds very closely with Mhaskar's figures on worms harboured by prisoners in the Trichinopoly Jail after various periods of imprisonment. Investigations on the correlation between worms harboured and eggs per gramme of fæces after different durations of infection, as well as the evidence furnished by Mhaskar's worm-counts, indicate that there is no appreciable falling-off in rate of oviposition with increasing age of worms, and that the drop in egg output is due to an actual loss of worms.

Evidently only a small percentage of worms which reach maturity in the intestine succeed in settling themselves in favourable locations, or else they have habits which make a long life improbable.

When unfavourably located, they apparently remain in the intestine for only a few weeks or months. Smillie's conclusion that hookworms are slowly acquired and slowly lost, based on the progressive slow increase of infection with age, does not appear to be tenable. It appears rather that the worms are rapidly acquired and rapidly lost, which results in the establishment of a similar equilibrium in a community. The slow rate of *net* acquisition of hookworms in children can be explained on the basis of habits. The rapid acquisition of hookworms after treatment when no precautions are taken against re-infection confirms this view.

Acute Mercuric Chloride Poisoning (L. A. Kohn, *Archives of Internal Medicine*, February 15, 1926).—Death from mercuric chloride taken by mouth may ensue within a few hours, from circulatory collapse, with little renal damage and no evidence of uræmia. Evidence is presented which suggests that direct myocardial damage may account in part, at least, for this early toxic death. In three severely poisoned cases, the white count reached 34,000 or higher in a few hours, and it is suggested that the degree of elevation of the leucocytes may be an index of the severity of poisoning with an unfavourable prognosis when levels of from 30,000 to 40,000 are found. While it is not denied that sodium thiosulphate may have value in treatment, it should be emphasized that it may fail to exert detoxicant action, and should not be administered to the neglect of established therapeutic methods.

On the Rate of Multiplication of Rabies Fixed-virus in Rabbits (J. W. Cornwall and W. A. Beer, *Indian Journal of Medical Research*, January, 1926).—Experiments have been carried out at the Pasteur Institute, Coonoor, with a strain of fixed-virus in its 940th passage. If this virus be subpassaged in rabbits, each subpassage animal being killed on the third day, the series cannot be continued beyond the second subpassage. If each subpassage animal be killed on the fourth day or later, the series can be continued indefinitely with no increase in the length of the incubation period. The rabies fixed-virus, therefore, does not multiply at such a rate that 0·01 grm. of brain substance can carry a lethal dose of it after two subpassages performed on the third day, but 0·01 grm. brain substance will always contain a lethal dose if the subpassages be made on the fourth day or later.

Certain Observations on the Mechanism of Quinine Hæmoglobinuria in Man (U. N. Brahmachari, *Indian Journal of Medical Research*, January, 1926).—A case is described in which the patient was accustomed to take quinine for attacks of malarial fever from which he was suffering from time to time but this was the first occasion on which he had hæmoglobinuria. The attack of hæmoglobinuria was of an intermittent nature, increasing during heights of fever and diminishing during apyrexia. During the stage of active hæmolysis, hæmolysis was going on in the liver just as in the case of quinine hæmoglobinuria. Though the patient gave a history of malarial attacks, he was found to be suffering from kala-azar. This is the second case in which hæmoglobinuria was manifested in a case of kala-azar.

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Original Communications.

OTES ON A CASE OF BRONCHOMYCOSIS.

By N. Chyurlia, M.D., Venice.

Mrs. N. N., an Italian woman, aged 42 years, ho belonged to a wealthy family, had suffered most continuously since childhood from bronchial tarrh. There is nothing worthy of note in the mily history. When she was eighteen years old e expectoration, which hitherto had been muco-rulent, became hæmorrhagic. At the age of 23 e married, and was left a widow three years later. he had two abortions, one at the second month d the other at the fifth month of pregnancy. In 19 she had a severe attack of influenza, localized the left lung, from which she completely re-vered. Many years of ill-health followed, and the tient had consulted several doctors. All agreed at she was suffering from chronic bronchitis. Some ggested the existence of cavities in the right ng; others noted symptoms of emphysema. Some vised mountain air, others the seaside. Hypho-ycetes and saccharomycetes were found in the utum. The patient followed all this advice, and so for years took balsamics, together with large ses of alkaline iodides (120 to 150 drops a day). At the end of 1922 the patient came under my bservation, and during 1923-1924 her condition owly but greatly improved.

Symptomatology.

(Excluding the Circulatory and Respiratory Organs.)

There is evidence of some deficiency in the general utrition, and the facies is constantly congested and yanosed.

The patient often presents slight rises of tempera-ure, subfebrile in character, and not preceded by igors nor followed by sweating, and lasting only a w hours. She takes good food; menstruation com-enced at fifteen, and the catamenial function is lways regular. The stomach, intestines, and the ver are normal, and the intestinal function is tonic. The spleen is normal and there is no renal tosis. The density of the urine is between 1,014 nd 1,020; and the urea is between 16·7 and 22·4 rm. per thousand. On rare occasions uric acid as been found, but never more than 0·40 per ent., and slight traces of indican. Constant ab-ence of albumin, peptone, glucose and other ehling-reducing substances. Mineral salts are in ormal proportions. The microscopical examina-ion of the urinary sediment showed scanty eucocytes, the usual histological elements of the rinary tract, sometimes small crystals of calcium xalate, of urates and of phosphates; and there are o signs of inflammation of the kidneys.

Symptomatology of the Circulatory and Respiratory Organs.

The pulsation of the apex of the heart is placed slightly to the left and the heart-beat extends out-wards. On percussion the cardiac dullness is en-larged through slight dilatation of the right ven-tricle. At auscultation accentuation of the second sound is noted. There are no murmurs to alter the clearness of the sounds in all sites of auscultation. The radial pulses are synchronous, a little distended, and the hypertension is confirmed by the fact that in the horizontal position of the body the number of the pulsations increases from four to six a minute compared with those with the body in the vertical position. The superficial venous system is much developed and passively congested.

Examination of the blood showed 3,800,000 red globules. The leucocytic formula presented the following percentages: Polynuclear neutrophils 77 per cent., polynuclear eosinophils 3 per cent., lymphocytes with azurophil granulations 3 per cent. Türck's cells 3 per cent., Rieder's cells 0·50 per cent., lymphocytes 4·59 per cent., lymphoid erythroblasts 1·50 per cent., plasma cells 1·50 per cent., transitional cells 2·50 per cent., mononuclears with eosinophil granulations 1·50 per cent.

The thorax is well-formed, cylindro-conical in shape. In the respiratory movements the right hemithorax does not follow the whole course of the left hemithorax. On percussion the sound is clear all over the thorax, rather higher on the left; but on the right beginning from the higher level of the eighth rib on the paravertebra and of the higher margin of the sixth rib, the sound becomes obtuse, passing immediately from a clear sound to absolute silence. The respiration is costal. There is no thoracic pain, neither spontaneous nor provoked. Râles are heard all over the right thorax. In the upper part of the right lung, along the internal margin of the scapula, the respiration is harsh, mixed with whistling sounds, especially on inspiration. Until last year the patient's respiration was noisy and could be heard at a distance; the voice was hoarse, and there was sometimes aphonia, gurgling râles, shortness of breath, and an almost permanent sensation of burning in the throat. Often the patient noticed the smell of fermentation in the breath, similar to the fermentation of beer, or sometimes, especially after expectorating, there was a sweetish taste and a putrid odour. The quantity of expectoration increased during the 24 hours (up to 400 500 c.c., and sometimes much more).

In a glass vessel the expectoration separated into three layers: the top layer was greenish, very thick, flaky, composed of thick sputum strongly adherent to the walls of the receptacle, it left on the glass a whitish line, opaque, scarcely soluble in water, and made up of deposits of fatty acids. It was this upper layer which had the characteristic aromatic, ethereal smell of fermentation. The middle layer was clear like water. The bottom layer had a granular aspect, homogeneous, it was often sprinkled with large, greenish, purulent, thick, compact flakes. Sometimes the expectoration was of a uniform slate-grey colour, other times yellow-reddish, almost orange colour, and very rarely the presence of unaltered blood could be seen. Cough was very frequent, especially at night; often it was harsh, dry, with difficult emissions of mucus, at times easy; fat followed by abundant expectoration was vomited.

These symptoms slowly disappeared, and during the last two years, having undergone a severe and appropriate treatment, the patient has greatly improved. The expectoration is reduced to a few cubic centimetres in 24 hours, the cough is rare, respiration easy, deeper, cannot be heard at a distance; the râles are limited to the base of the right lung, whilst the fermentation and the putrefaction have completely disappeared.

Microscopical Findings in the Expectoration.

Investigations relative to the pathogenic agent from a therapeutic point of view can be divided into three periods. The first period, very long, comprises all the years of the patient's illness up to 1922. During this time microscopical researches on the expectoration were scarce and uncertain. It seemed sufficient for the doctors to exclude Koch's bacillus, and only very recently the presence of a hyphomycete was verified (not defined or characterized) in the sputum. The second period is from the end of 1922 to August, 1924. During this time the patient was under my care. During this period about 40 examinations of the expectoration were made. These examinations not only confirmed the exclusion of Koch's bacillus, but admitted the constant presence of a blastomycete (saccharomycosis) well stained by Nicolle's method, Gram-negative, made up of numerous ovoid or ellipsoid corpuscles, often united at the polar extremity, surrounded by capsules, with protoplasm finely granular, and sometimes vacuolated, about 3 or 4 microns × 5 to 7 microns in size (Koritska ob. 1/15 in. semi-ap. ad. imm. ocul comp. 4). I was certain, therefore, that the case was one of blastomycosis. From September to December, 1924, the patient was in the hands of another doctor, who prescribed 24 injections of autovaccine without any appreciable results. In December, 1924, the third period began. Frequently at the microscopical examination of the expectoration very fine filaments could be seen, often mixed with roundish corpuscles. Their presence coincided with a larger number of small, round cells of the bronchial epithelium and with the periods of recrudescence of the clinical symptoms.

I had already carried out some cultures with the sputum, on Sabouraud's agar, in which a germ was detected and suspected to be a monilia. This doubt was cleared up by the mycological diagnosis of the eminent Professor Castellani, who confirmed the presence of *Monilia krusei* (Castellani 1909).

The mycological and bacteriological investigations, the experiments on animals and the experimental therapeutic tests have now been handed over to Doctor Redaelli.

Therapy Used.

It is impossible to describe all the means used. A precise idea can be gathered from the fact that for many years of the first period, up to 1923, the patient had made great use of balsamics, and alkaline iodides by the mouth. From 1923 to August, 1924, I had given large doses of iodide in the form of daily injections of sidiodal and of oil-iodine simple and guaiacolated, together with inhalations of balsamics. By this treatment the condition of the patient was remarkably ameliorated. During September-December, 1924, autovaccine injections gave no results. I advised the use of a special autovaccine according to Steinfeld, the use of alkalines by the mouth, which proved very efficacious, the application of ultra-violet rays, the continuation of the iodides and the other therapeutics which might be suggested from the experimental studies. All this is now being done, and good results have already been obtained.

LEPROSY IN A FOURTEEN MONTHS OLD CHILD.

By E. A. Neff,

Medical Superintendent, Leper Station, Makogai, Fiji.

All authorities, I think, agree that leprosy is a disease that rarely attacks those under five years of age. The youngest case I have seen hitherto reported was that of a child aged nineteen months and described by Drs. William J. Goodhue, Medical Superintendent, Malokai Leper Settlement, and George W. McCoy, Director United States Leprosy Investigation Station, Hawaii, in *Public Health Bulletin*, No. 75, of January, 1916.

The history of the case is as follows: A female child (Alexandrina) was born at this station on December 5, 1923. The mother, an Indian, being a well advanced nodular leper and the father a healthy Indian of perhaps 23 years of age. The mother was admitted pregnant. At the birth of her child the mother's disease was particularly active, and since her admission in June, 1923, she had not responded to treatment. The confinement was normal, as was the puerperium. Almost immediately following her confinement, the mother had a very severe reaction with fresh and extensive infiltration of the skin. This was followed shortly by two or three milder reactions. On account of the child's delicate state of health during this time she was allowed to nurse it until this was precluded on account of leprotic infiltration of the nipples.

The mother has a sister here, a mixed leper. She has one other child, a boy aged four years, who has not developed leprosy.

The patient has never been a robust child, but has developed along normal lines. The only diseases she has had, other than this, are a mild attack of dysentery and scabies. On February 12, 1925 arrangements had been made whereby she was to be sent to her father, in Levuka, when a papular nodule was noticed in the centre of her left cheek (it is quite certain that this lesion had been present for at least three months, but had not shewn typical and so had not been suspected). This was incised and a smear taken, which, when examined, showed all fields filled with acid-fast bacilli in characteristic grouping. Nasal smears taken on this date from each nostril were negative. Examination of her skin showed several very small depigmented areas

over her right shoulder and over her back. These, in my opinion, were not leprotic. Otherwise skin findings were negative. Repeated examinations of this nodule, which gradually increased in size, showed bacilli until July 15, when nothing could be demonstrated. In connection with nasal smears it is interesting to note that repeated smears were negative until February 21, when each nostril showed highly positive, the bacilli being typical, numerous, and in definite grouping. On July 7 two new very small nodules appeared, one just external to the left eye, and the other in front of the right ear.

TREATMENT.

Weekly intramuscular injections of Burroughs Wellcome's "moogral" have been given to her throughout in 1 c.c., increasing to 2 c.c., doses. The drug has latterly been given in combination with olive oil, camphor, and resorcin.

Since September, 1925, her disease has remained stationary and inactive, and she has been bacteriologically negative. The initial nodule shows as a typical scar, the size of a shilling, and the marks of the smaller nodules can scarcely be seen, so small are the scars.

Dr. ALDO CASTELLANI has just returned from America where, at the invitation of the authorities of the Tulane University, New Orleans, he has established and organized a tropical medicine division in the medical school. During his visit he had the honour of being invited to deliver the Gehrman memorial lecture series at the University of Illinois; and later, at the Annual Convention of the American Medical Association and its Medical Exhibition on scientific subjects, he was awarded the Gold Medal, the highest recognition which can be given by the association. The award "was based on the excellent investigation in comparatively unexplored fields of medicine and for the perfection of the display" of specimens.

Intravenous Administration of Sulpharsphenamin in Syphilis (M. F. Lautman, *Archives of Dermatology and Syphilology*, February, 1926).—In cases of syphilis which are Wassermann-negative and free from clinical symptoms, sulpharsphenamin seems quite as capable of controlling the disease as the old arsenicals. From personal observations by the author as well as the observations of others, it seems that sulpharsphenamin in neutral syphilis is even more effective than arsphenamin or neo-arsphenamin. Given intravenously, sulpharsphenamin did not produce dermatitis and caused practically no constitutional reactions. On account of the absence of disagreeable reactions, patients submit more willingly to treatment with sulpharsphenamin, and, consequently, it is indicated in cases in which the maximum spirochæticidal effect of arsphenamin and neo-arsphenamin is not essential.

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MAY 15, 1926.

PUBLIC HEALTH ON THE GOLD COAST.

IN 1914 the staff of the Sanitary and Public Health Department of the Gold Coast consisted of eight officers, whereas to-day it comprises seven

officers only. As Sir William Simpson[1] points out, this organization for a country the size of Great Britain is obviously insufficient, and that although even with this small staff much good work has been done, it is, nevertheless, too small to secure continuity of policy or the progress that is needed. The necessary periodical leave also leads to frequent transfers, so that extra work under pressure is thrown on to others who have to carry on the duties. In addition to an increase in the numbers of the present staff it is also suggested, at least as a beginning, that one inspecting health officer should be appointed for each province. There are three provinces in the Gold Coast Colony and two in Ashanti, the Western and Eastern Province, but the Eastern Province is so large that it could advantageously be divided into two administrative health areas with an administrative health officer in each. The mandated territory of Togoland must also be considered, and this would also require at least one provincial health officer. Thus, providing for leave nine of these officers would be required. As regards the Northern Territories, however, the provision of health officers might be deferred until the suggested inquiry into the conditions of health of these territories has been completed.

It is suggested that it would be the duty of these provincial health officers (1) periodically to visit and inspect the towns in which medical officers of health and medical officers are located in his province; (2) to inspect from a health point of view the conditions under which labour is being carried out in large works, such as railways, harbours and road construction and in the numerous mines that are being opened up, and which have no medical officer responsible for the welfare of the workers; (3) to arrange that borrow-pits caused by railway construction at stations where villages and towns have sprung up, to be drained and filled up; (4) to visit the districts in their province during the cocoa season and keep a watch on new centres of trade springing up; (5) to visit the more important villages and assist the district commissioner in the endeavour to encourage the chiefs to have their villages cleaned up and built on suitable lines; (6) to visit and inquire into the source, advise and assist the medical officers of health in any outbreak of an epidemic or infectious disease such as plague, yellow fever, cerebro-spinal fever, small-pox, &c., which occurs in the province.

At the same time there should also be a closer association between the engineering and sanitary services and between the Medical Research Institute and the sanitary services than exists at the present time. It is unfortunate that the excellent laboratories in Seccondee are at present closed on account of shortage of staff. The dearth of expert staff in the laboratories is specially dangerous for a seaport where bacteriological, pathological and chemical investigations safeguard against outbreaks of disease, where facilities are also required for the bacteriological and chemical examination of drinking water and food-stuffs, and where the diagnosis and treatment of doubtful cases can only be cleared up by a laboratory report.

Branches of the Medical Research Institute at Accra are needed and should be adequately staffed at Seccondee, Coomassie and Cape Coast.

For the more effective prevention of the spread of epidemic disease such as plague, yellow fever, cerebro-spinal fever, small-pox and other important infectious diseases, it is essential that every department of the public health in the colony should be informed as soon as possible of their occurrence and the locality affected.

Lastly, Sir William Simpson also suggests that a weekly bulletin giving the name and number of each infectious disease occurring in each locality should be issued by the Central Health Office to the medical officers of health, the provincial health officers, the laboratories of the Medical Research Institute and its branches, and to the senior medical officers in the different towns and stations, and, where there is no medical officer, to the District Commissioners. If there can also be added similar information regarding the existence of these diseases in countries adjacent to and in communication with the Gold Coast it would greatly add to the value of the bulletin.

F. E. T.

[1] Report to the Secretary of State for the Colonies on the Sanitary Condition of the Mines and Mining Villages in the Gold Coast Colony and Ashanti. By Professor Sir William Simpson, C.M.G., M.D., F.R.C.P., D.P.H. Published for the Crown Agents for the Colonies, 1925.

Annotations.

The Destruction of Rat-Fleas by Heat on Board Ship (R. K. Shaw, *Journal Royal Naval Medical Service*, October, 1925).—The experiments reported were conducted on board H.M.S. *Endeavour* during February and March, 1925, the ship being then engaged in surveying duties off the West Coast of Africa. The fleas used in the experiments were obtained by bringing on board some thirty black and brown rats, killing them and combing out the fleas. Although the available material was not large, the experiments admit of the following conclusion: All rat-fleas are capable of being destroyed in a dry blanket (not more than twice folded) if exposed to a temperature of 110° F. for a period of three hours—such a temperature was found to be constantly present in various parts of the engine room in H.M.S. *Endeavour* while at sea. Fleas are able to withstand a high temperature for a prolonged period if kept moist. This resistance is not due entirely to the action of moisture in delaying penetration of heat. If blankets and clothing are quite dry and so arranged as to give free access of air at a minimum temperature of 110° F. to every portion of the articles, rat-fleas on such articles will be killed within a period of three hours. This method of killing fleas has proved to be of practical value on such a ship as the *Endeavour*. It would be of interest to ascertain whether other ships provided similar facilities.

An Outbreak of Rat Poisoning probably due to Rat Virus (R. S. Spray, *Journal of the American Medical Association*, January 9, 1926).—The epidemiologic evidence, confirmed by bacteriologic and serologic findings, indicates that the outbreak of 123 cases of acute gastro-enteritis among the girls eating at the women's hall of West Virginia University and of twelve cases among the kitchen personnel, was due to contamination of some food with a commercial rat virus, which was distributed just sixteen days previous to the outbreak. Paratyphoid bacilli of the same type were alive in the original bait on the serving room floor twelve days after the outbreak. Flies and ants were abundant and had access to the baits as well as to the kettle in which the bait was prepared. In addition, at least three persons mopped the floors daily with hand-wrung mops, which undoubtedly had contact with the baits, and from this duty went directly to the preparation of foods. The epidemiologic evidence indicated that milk, or milk and cream, was the probable vehicle of the infection. If milk was responsible, the contamination evidently occurred subsequent to delivery from the dairy. The isolation of a recognizable organism from fourteen students, and the identity of these strains, in all respects tested, with organisms isolated from the rat bait and with the rat virus from the commercial package, serves to support and corroborate the other evidence.

Studies in the Common Cold. I. Observations of the Normal Bacterial Flora of Nose and Throat with Variations Occurring During Colds (G. S. Shirley, F. M. Hanger, and A. R. Dochez, *Journal of Experimental Medicine*, March 1, 1926).—The normal bacterial flora of the nose and throat of thirteen individuals has been studied over periods ranging from five to nine months. Observations have been made by the authors of qualitative and quantitative changes in the flora occurring in the course of colds and of throat infections appearing in the group. The normal basic nasal flora includes *Staphylococcus albus*, diphtheroids, and for certain individuals *Staphylococcus aureus* and *B. influenzæ*. Occasionally transient bacteria and Gram-negative cocci and non-hæmolytic streptococci. The normal basic throat flora includes Gram-negative cocci, non-hæmolytic streptococci, and for certain individuals "large Gram-negative cocci," *Bacillus influenzæ*, Bacillus "X," and diphtheroids. Transient organisms are *Staphylococcus albus*, *B. mucosus*, and pneumococci. No bacteria were found in early cold cultures to which a causative rôle could be assigned. In the course of colds the basic flora of the nose was often scanty in the early stages. The throat showed reduction of prominence or alterations in predominance of the basic flora. Certain organisms were prominent in colds, usually as late or secondary invaders: these included *Staphylococcus aureus*, hæmolytic streptococci and *B. influenzæ*. There was a striking increase in the incidence of hæmolytic streptococci in throat infections.

Effect of Compound Solution of Iodin and Rest in Surgery of Exophthalmic Goitre (H. M. Clute, *Journal of the American Medical Association*, January 9, 1926). Compound solution of iodine has been used in the treatment of two hundred cases of primary hyperthyroidism in the Lahey Clinic. A study has been made of the effects of this treatment in this group of cases, of which sixty-nine have been especially selected for detailed presentation. Rest in bed from seven to ten days before operation is of great importance in pre-operative preparation. Before the use of compound solution of iodine and rest in bed, only 38 per cent. of the patients were operated on in one stage. Since the use of the solution and rest in bed preoperatively 63·7 per cent. have been operated on in one stage. The number of pole ligations has decreased from 51 per cent. in the past to 13 per cent. in this series of cases. In the eighty-five cases of primary hyperthyroidism in which operation was performed during the first five months of 1925, no pole-ligation has been necessary. Of the patients in this group 7·2 per cent. failed to show an appreciable drop in metabolic rate after the use of the solution and rest. The results following subtotal thyroidectomies are similar. Iodine administered over long periods without thyroidectomy does not cure exophthalmic goitre. Thyroidectomy must be added to produce a complete return to normal health.

Cutaneous Reaction in Leishmaniasis (Joao Montenegro, *Archives of Dermatology and Syphilology*, February, 1926).—Intradermal injections of an alkaline extract of *Leishmania* were given to thirty-seven patients with leishmaniasis, and positive reactions were obtained in thirty-two or 86·5 per cent. Injections with the same extract were also given to thirty-six persons free from leishmaniasis. Of these, thirty-three developed negative reactions and three showed a certain reaction definitely distinct from the specific reactions obtained with the patients who had leishmaniasis. It was much less intense. The cutaneous reaction of leishmaniasis is specific, and for this reason when typically positive is of itself sufficient to confirm the diagnosis, if the patient has never had leishmaniasis before. A negative reaction reduces to 13·5 per cent. the possibility that the disease is leishmaniasis. The result of the reaction should not be accepted without knowledge beforehand concerning the specific value of the extract. Positive reactions were obtained in all stages of healing. The extract prepared from a strain of *Leishmania tropica*, or oriental sore, provoked a specific reaction in the bearers of the Brazilian type of *Leishmania*.

This argues in favour of the unity of the alleged species. There has been no opportunity to produce the cutaneous reaction in patients cured of leishmaniasis.

Report.

MALARIA-CONTROL IN CEYLON PLANTATIONS.[1]

By Sir RONALD ROSS, K.C.B., K.C.M.G., F.R.S.,
Director-in-Chief, Ross Institute and Hospital for Tropical Diseases, Putney Heath, S.W. 15.

ON October 26 last year I addressed the Ceylon Association regarding Malaria-Control in Tropical Plantations. I was obliged to speak on the general subject because I then possessed little experience of the local conditions in Ceylon—with which we are specially concerned; but I emphasized the importance of malaria-control in warm climates and urged that the only way to achieve it in tropical plantations is for the affected plantations to organize a system under which they can always obtain expert advice regarding their own particular problems of defence. Following upon this lecture it was suggested that I myself should go to Ceylon in order to study the subject at first hand. The Ross Institute, which has been founded for such purposes and has received much welcome support from Ceylon, assented; and the expenses were generously guaranteed by the Colombo Commercial Company; by Messrs. Rowe, White and Co.; by the Ceylon Tea Plantations Co.; by Messrs. Harrisons and Crosfield; and by the Grand Central (Ceylon) Rubber Estates. Consequently, I left Liverpool by the Bibby Line on December 11, 1925, and arrived at Colombo on January 4, 1926. I remained in Ceylon for more than six weeks, left Colombo on February 17, and returned to London via Marseilles on March 7.

On arrival in Ceylon I received a very kind welcome from His Excellency the Governor, Sir Hugh Clifford; from the Hon. Dr. J. F. E. Bridger, Principal Civil Medical Officer; from Mr. H. F. Carter, the Government Malariologist (who had been with me at the Liverpool School of Tropical Medicine years previously); and from many other gentlemen. Next day, Mr. W. Forsythe (a member of the Council of the Ross Institute) and Mr. C. D. Sparkes took me for a preliminary survey of estates in the Kelani Valley; and on the same day I gave an address to the Ceylon Estates Proprietary Association at Colombo, Mr. G. C. Slater in the chair. On January 8 I addressed the Planters' Association of Ceylon at Kandy, Mr. J. W. Oldfield in the chair. Meanwhile, my tour among the estates was arranged by Mr. Slater, Mr. Forsythe, and Mr. C. L. Carson-Parker; and during the tour I was invited to address the planters at Tebuwana Club on January 16; at Kaluganga Gymkhana on January 20; and at Ratnapura on January 30. My warm thanks are due to the kind hosts who entertained me during the tour—to Mr. H. W. Roy Bertrand at Govinna Estate; to Mr. and Mrs. E. C. Hawkins at Dumbara Estate; to Mr. E. Gordon Brooke at Hanwella Estate; to Mr. and Mrs. A. J. Ingram at Pelmadulla Estate; to Mr. and Mrs. C. de E. Collin at Pitiakande Estates; to Mr. J. Sheridan-Patterson at Delwita Estates; and to Mr. H. D. Garrick (to whose enthusiasm for the Ross Institute it is so much indebted) at Ukuwela. I am also much obliged for hospitality and also for information to Mr. and Mrs. Slater; to Mr. and Mrs. Oldfield; to the Hon. Mr. and Mrs. Kindersley at Kandy; the Hon. Mr. T. L. Villiers, Mr. John Still, Mr. Blythe, Mr. and Mrs. Wedderburn, and Mr. Sudbury at Anuradhapura, and to other obliging friends. At Anuradhapura, Mr. Carter, the Government Malariologist, and Mr. W. H. Schokman, who assists him there, showed me their careful and successful mosquito-control works now in course of elaboration. Before departure, I broadcasted on the subject of malaria at the Central Telegraph Office, and again addressed the Ceylon Estates Proprietary Association on February 15; and lastly, received the hospitality of their Excellencies, Sir Hugh and Lady Clifford at Colombo. My only regret is that want of time compelled me to decline some invitations to lecture and obliged me to forgo calling upon some gentlemen whom I particularly wished to see. I am also much indebted to Sir James Lochore and to Mr. W. Shakspeare (Vice-Chairman of the Ross Institute) for valuable assistance; and last, but far from least, to Mr. G. H. Masefield for his fully-informed and whole-hearted support of malaria-control in Ceylon, as well as for organizing my visit there.

It will be unnecessary for me to repeat the general remarks on malaria which I made before the Ceylon Association last October; but it is advisable to re-emphasize some points there dealt with. One cannot say that beyond a few special anti-malaria campaigns here and there, the British Empire has fully utilized even yet the discovery that malaria is carried by *Anopheles* mosquitoes—which was made in 1898-99, more than a quarter of a century ago. The explanation of this delay is that, theoretically, malaria may be prevented in several different ways (namely, by the use of mosquito nets, by the application of "culicifuges" to the skin, by the regular taking of quinine, by segregation, and by the general method of mosquito-control) so that sanitary officers have been divided by their own embarrassment of riches in regard to malaria-prevention: some have preferred one method and others have preferred another method, while the Governments of our tropical dependencies have never been able to allot large enough funds for any of such works on general scales. The great successes against malaria, namely, those in the Federated Malay States, in the Panama Canal zone, and in the Suez Canal zone, have been effected by wealthy companies

[1] A report delivered to the Ceylon Association, London, on April 9, 1926.

rather than by Colonial administrations; and Governments can scarcely be expected to allot large sums until a full decision has been reached regarding the best manner in which to employ those funds.

During the whole of this "negative phase," however, there has been a steady advance in one direction, due partly to enthusiastic medical men and partly to well-trained entomologists—I mean the determination of the exact species of mosquitoes which carry malaria in different countries and the detailed observation of their habits, their breeding places, their seasonal prevalence, and their capacity as carriers of the disease. These studies have been set forth in a number of admirable scientific publications—which, of course, are little known to the general public. It cannot be any longer pretended, as was pretended twenty years ago, that we do not possess sufficient knowledge of mosquitoes to justify us in spending money for controlling them. But, as I have said, though we have now obtained all or most of the knowledge necessary for mosquito-control, yet the final stage of active public mosquito-repression has scarcely been reached even now.

But there is one direction in which I have observed a very distinct improvement. Apart from the *Anopheles* mosquitoes which carry malaria, there are in the tropics, as everyone knows, a number of domestic species belonging chiefly to the genera *Culex* and *Stegomyia*, which commonly infect all human dwellings and which cause much annoyance to human beings, while they even sometimes carry dengue, yellow fever, and filariasis. The whole time that I was in India, from 1881 to 1899, I always observed that these species tended to swarm in private houses, hotels, and even in hospitals; and I frequently estimated that, in spite of mosquito-nets, punkas, fans, and thick socks, I was bitten at least two or three times every twenty-four hours by one species or another. In some places the plague of mosquitoes became more than a mere annoyance—for instance, I remember my own miserable experiences when I stayed for a night in a Colombo hotel in the year 1888. The insects abounded everywhere in the tropics. They would bite one's ankles at dinner parties and would show extreme intelligence in entering mosquito nets with the smallest holes in them. Even so late as 1902, when Sir William McGregor and I stayed in the Suez Canal Company's houses at Port Said and Ismailia (whence the mosquitoes have now been banished) we were plagued almost beyond endurance by them. I have not visited India again since 1899 (except for a week's stay at Bombay in 1908), until the visit to Ceylon now being dealt with; and I notice an immense change in this respect. During the whole six weeks of my stay I do not remember to have been bitten once (though I am a very popular subject of mosquitoes' attentions), and I saw only about six mosquitoes the whole time, during which I resided in four large hotels and in seven planters' houses, and visited several other buildings. Doubtless the domestic mosquitoes still continue to abound in many private houses, in native huts and habitations, and elsewhere; but the improvement already manifest in the hotels and other places mentioned is a welcome augury for the future. The mere comfort of life in the tropics is vastly enhanced by the absence of these little pests, the common domestic mosquitoes. The improvement has been due simply to the spread of knowledge. Nearly everyone in the tropics now knows that mosquitoes may carry diseases and that they breed largely in gutters, in pots and tins round houses, in water-butts, and in roof-gutters. Intelligent persons can reduce the plague in their own houses in many places, though certainly not in all. The improvement has been a subconscious one, which can scarcely be detected except by those who, like myself, have had a long previous experience of tropical life.

Malaria, however, is not carried by these domestic species of mosquitoes, but by the *Anopheles*, most of which breed in natural ground-waters apart from habitations or not necessarily close to them. No single householder can decree the banishment of *Anopheles* from his house simply by looking after his own premises. For *Anopheles* concerted public action is necessary. And now I have great pleasure in recording the admirable work done recently in Ceylon by the Public Health Department of the colony, especially by Dr. Bridger and the malariologist, Mr. Carter. Mr. Carter was appointed only a few years ago, but has already done an immense amount of detailed, but necessary, researches on the mosquitoes in the island, especially the *Anopheles*. His office in Colombo is a useful, though not a large one; and it has been collecting extensive records of the habits and distribution of the insects—with the assistance of several capable workers. Carter's brochure on the "Anopheline Mosquitoes of Ceylon" (*The Times of Ceylon* Co., Colombo, April, 1925) is a brilliant little compendium, and his reports already published in the "Annual Report of the Medical Department, Ceylon," for 1924, pages 3 and 53, give much exact knowledge necessary for malaria-control throughout the island. During my visit he was engaged upon writing a still fuller report; and I am glad to hear that his services are to be continued in the colony. We may be convinced that under Dr. Bridger the work of malaria-control will be pushed as far as funds and circumstances allow. In fact, the malariological department is another advance far beyond anything which I saw in the East before I left it in 1899. With enlargement, with more generous financial support, and with the more enlightened assistance of the whole public in Ceylon, it will, I am convinced, effect a very great improvement as regards malaria throughout the colony.

Another piece of work done by Mr. Carter has been to make an estimate of what are technically known as spleen-rates in Ceylon. This test consists in ascertaining the proportion of people in any locality who show enlargement of the spleen—a pathological condition due, with rare exceptions, in Ceylon only to malaria. I need not discuss the method here. It has been employed throughout the tropics for many years. Roughly speaking, the

larger the spleen-rate, that is, the greater the proportion of people with enlarged spleen in a locality, the greater the rate of malarial infection in that locality. Further refinements are obtained by noting the average sizes of enlarged spleens in the inhabitants; and the test is specially valuable amongst the new comers, that is the children. Mr. Carter has prepared many maps showing the spleen-rates in very many areas all over Ceylon, and I was able to verify some of these rates in the neighbourhoods visited by me. From these it appears that malaria is most prevalent, as he says, in the plains to the north and east of the central mountain mass; and this fact is largely, if not quite fully, explained by the special prevalence of the malaria-bearing species of *Anopheles* in the affected districts.

All these are technical matters which it is unnecessary for me to discuss here, as they have been already fully dealt with in the reports of Dr. Bridger and Mr. Carter. I myself was concerned specially with malaria in the plantations, and the best organization for dealing with it. Here we may remark, to begin with, that the official Malaria Department, appointed and paid for by Government, is necessarily concerned chiefly with the towns and villages of the general population. As with sanitary departments elsewhere, it cannot with its present income and organization deal fully with private estates, that is, with large rural areas distinct from the civil population. Government keeps an eye on housing schemes, general sanitation, hookworm disease, and other communicable maladies; but the public funds now available will scarcely suffice for anti-malaria sanitation for the whole of the 25,365 square miles in the island. The main point for me to consider, then, in reporting upon malaria-control on private estates in Ceylon was concerned with the best organization for this special purpose.

Two courses appear to be open to the planters, namely:—

Scheme A.—To contribute funds to the Colonial Malaria Department in order to enable it to inspect and advise upon malaria-control for every malarious plantation, as well as for the general population.

Scheme B.—To appoint one or more Plantation-Malariologists for the special purpose of dealing with plantation-malaria—to work, of course, in touch with the Government Malaria Department as much as possible, but to be supported by the estates.

I had several conversations with Dr. Bridger and Mr. Carter on these points, and also consulted the Office of the Colonial Secretary about them. Regarding Scheme A, there appears to be some difficulty as to whether Government would accept *ad hoc* contributions from any private properties. This point could not be decided during my brief visit; but, personally, I should think that arrangements ought to be quite feasible, given goodwill on both sides. The Colonial Malaria Department would have to survey all the malarious estates in order to detect the breeding areas of the mosquitoes, and would then have to advise and help managers of the estates as to how best to deal with these breeding areas. This would imply merely an enlargement of the staff of the Malaria Department enabling it to cover the estates as well as the towns and villages of the general population. What I had in mind under this heading was that the planters might contribute an annual sum to the colonial revenue, but ear-marked for the express purpose of malaria control in the plantations, in order to provide as many assistants to the Colonial Malaria Department as it would require to enable it to deal with the malarious estates. But this would involve certain administrative difficulties between the planters on the one side and Government on the other, and I was not sure when I left Ceylon that these administrative difficulties could be overcome.

If they cannot be overcome, then the planters should take steps to appoint special malariologists for looking after their own estates (Scheme B)—as has been done so successfully by the planters in the Federated Malay States, assisted by Sir Malcolm Watson, Mr. C. Strickland, and other gentlemen there. Under this heading I should strongly advise the planters to acquire the services of at least one active, fully-trained and qualified European to advise all the malarious estates, with necessary assistance. Unfortunately, the number of such men available is by no means large at the moment. I fear I can suggest only a few names, while men who are sufficiently qualified for the work and also possess a knowledge of local conditions in Ceylon are very few indeed. Whoever is appointed must be given a proper salary, with sufficient tenure, and some arrangements for a pension, because a short-time man will scarcely be able to throw his whole heart into the subject. He must be provided with a house at a central spot, a motor car, and also a small laboratory; and will certainly need some native assistants, and perhaps even a European one later on, at least during the malaria season. His work will be fairly heavy until he has made accurate malaria surveys of the affected properties, and his time should not be spent on hospital or other medical practice; but perhaps other sanitary duties in connection with the estates may be entrusted to him subsequently—so that he might ultimately develop into an Estates' Health Officer. Several of us who considered the matter together thought that the cost would be about £2,000 a year, at least. This would be exclusive of the cost of the actual mosquito-control measures, which would have to be borne, when possible, by each affected estate for itself. Whether Government would render financial help for Scheme B I cannot say, but it may be asked for.

On the other hand, Scheme A might cost the planters less because their malariologist would be already provided by the Government Health Department and the estates would have to pay only for such assistants as he might require for inspection and supervision in them. In both cases they will probably have to pay at least part of the cost of the actual mosquito-control measures, whatever these may be.

I laid these alternatives before the Ceylon Estates Proprietary Association before my departure; but

iscussion regarding them was not then sufficiently lvanced to enable me to advise definitely which them would be the better one. I formed such a gh opinion of the Government Malaria Depart- ent that I should like to see the whole anti-malaria ork in Ceylon placed under it, if possible, for the ke both of economy and of unity of control cheme A). Failing this, the second alternative cheme B) should be adopted—and I can see no ird course available.

Both alternatives will be, and must be, a source expense. All malaria-control, and, indeed, sani- tion in general, is a source of expense. But it is t yet always clearly apprehended that malaria, e other diseases, is also a source of expense—and ually of much greater expense than preventive easures are likely to be. It is useful to consider is subject from a strictly business point of view, ite apart from humanitarian interests. Every se of malaria, both among staffs and among bourers, costs money; and sometimes large sums money have to be wasted under this heading.

Here, for example, is a table prepared by one of the ost capable rubber planters in Ceylon before my rrival (except for the last column). It gives the ctual loss in the tapping of the rubber-trees due to hortage of labour caused chiefly by malaria in ecember and January last in a group of five estates nder him. Estate I is some hundreds of feet up n the hill above the plain; Estate II is lower down nd nearer the plain; and Estates III, IV and V are ght out on the plain away from the slope of the ill.

It will be observed that the cost of the malaria ncreases in the same order. Now I took the spleen- ates on the first four estates before I had seen the anager's table; and these spleen-rates are here ntered in the last column. It will be seen that hey vary remarkably in agreement with the mone- ary loss shown by him. That loss amounted to early £1,000 for the five estates in January alone, nd varied from nil on Estate I on the hill (with a pleen-rate of only 15 per cent.) to a sum of Rs.5,579 n Estate IV on the plain (with a spleen-rate of 76 er cent.). The increase of the spleen-rates (and f the pecuniary losses) in the estates on the plain was due to the greater frequency of the breeding-waters of the dangerous *Anopheles* there than on the slopes of the hill.

I have no doubt that similar figures can be obtained for all the estates in the island; and, besides the waste of productive labour, numerous other expenses are caused by the disease—hospital and other medical expenses, maintenance of families, and so on. My main argument is, therefore, why waste thousands a year in consequence of malaria when a few hundreds a year may suffice to prevent or at least to diminish it? Even if the preventive measures cost as much as the malaria costs (which will probably be very seldom the case), the humanitarian benefit in the saving of sickness and death will still turn the scale in favour of prevention. There is no alternative left—either prevent your malaria or continue to lose thousands a year in consequence of it.

How should the money be raised to pay either for Scheme A or for Scheme B? Evidently by subscription. The planters themselves must agree upon the terms; but the following points may be submitted for their consideration. The Ceylon estates may be classified as follows:—

Group 1.—Estates (chiefly tea-estates) which are above or outside the malaria range and on which only imported cases occur.

Group 2.—Estates within the malaria range, but on which epidemics of malaria occur only occasionally.

Group 3.—Estates whose coolies become infected from adjacent areas such as neighbouring estates, or towns or villages.

Group 4.—Estates whose malaria is due to their own mosquito-breeding areas.

Until complete malaria-surveys of all the estates have been made, it will be difficult to say to which group any one estate belongs, except perhaps those happy plantations of Group 1 which are entirely above the malaria range. On many estates malaria may be absent to-day but may abound to-morrow (Group 2), and then in consequence either of contiguous foci of infection (Group 3) or of their own breeding waters (Group 4). Malaria is a disease which is by no means always fixed to the same localities, but of which wide epidemics may occur (as shown by numerous careful investigations). In

MALARIA-EXPENSES AND SPLEEN-RATES ON A GROUP OF FOUR CONTIGUOUS ESTATES IN CEYLON.

	December, 1925, tapped 31 days.				January, 1926, tapped 27 days.				
	Number of tapping blocks of trees	Actual tapped	Shortage	Total loss in money	Number of tapping blocks of trees	Actual tapped	Shortage	Total loss in money	Spleen-rate
				Rs. cts.				Rs. cts.	Per cent.
state I ...	527	495	32	299.20	476	476	Nil	Nil	15
state II ...	310	266	44	411.40	270	234	36	367.20	51
state III	1798	1587½	210½	1967.75	1566	1141	425	4335.00	76
state IV	1209	713	496	4637.60	1053	506	547	5579.40	76
state V ...	1230	997½	232½	2173.45	1148	887	261	2662.20	Not taken
Total...	5074	4059	1015	9489.40	4513	3244	1269	12943.80	

Total crop in December 22896 lb. at 5½ lb. per coolie, 5582 lb. loss at Rs. 1.70 = Rs. 9489.40.

Total crop in January 19874 lb. at 6 lb. per coolie, 7614 lb. loss at Rs. 1.70 = Rs. 12943.80.

such epidemics the estates of Group 1 may be put to considerable expense in consequence of imported cases, and even such estates are therefore distinctly interested in the whole subject. I conclude, therefore, that it would be proper for *all* the estates to join in the malaria subscription; and as many estates (Group 3) suffer from infections contracted in neighbouring houses, villages, and towns, I think that Government may justly be asked to assist either Scheme A, or by adding an adequate sum to Scheme B. If all the estates in Ceylon can be persuaded to subscribe, the total cost to each would be inconsiderable as regards the malariological department itself; but actually malarious estates (Group 4) would still have to bear the cost of dealing with their own breeding waters, unless neighbouring estates or Government can be induced to help—as may often be the case. Pending consultations and decisions on these points, I advise the more progressive estates to raise a " malaria subscription " at once among themselves and to set to work without delay. They are likely to save much of the money they are now spending in consequence of the disease; and other estates are sure to join them as soon as good results become manifest. All the main scientific facts have been demonstrated for many years; and there is no good reason for procrastination.

The Ceylon Public Health Department has already commenced considerable schemes for malaria-reduction at Trincomalee, at Anuradhapura, at Mahara Prison, and elsewhere, chiefly by mosquito-control. Apart from older attempts in this line, a campaign has recently been described in the Supplement to the *Indian Medical Gazette*, March, 1926, page 1, which says: " Mr. R. Senior-White, F.E.S., records the eradication of malaria from a rubber estate in Ceylon with a total population of 357 souls. From 1914 to 1921 malaria cost the estate approximately Rs. 831 per annum in loss of working days, and the population of 357 showed an annual average of 830 admissions to hospital for malaria. The expenditure upon prophylactic quinine was Rs. 352 per annum. In 1919 a survey was carried out, and *Anopheles maculatus* (an Anopheline mosquito) incriminated. Its breeding places were thoroughly dealt with, chiefly by oiling, at a cost of Rs. 195 per annum. The annual average number of deaths from malaria dropped from 13 to 4, with an estimated saving of Rs. 480 per annum on increased number of days' work. The example is a small one, but it is typical of results which can be multiplied almost indefinitely upon a much larger scale." See also a paper by Mr. Senior-White in the *Bulletin of Entomological Research*, January, 1926 (Imperial Bureau of Entomology, 41, Queen's Gate, London, S.W.7), which has just reached me.

In 1902-3, the Suez Canal Company, acting on my advice, entirely cleared its capital town, Ismailia, of mosquitoes, *Stegomyia*, *Culex* and *Anopheles* (and also of its malaria), and a few years later, Dr. E. H. Ross achieved the same result at Port Said. When we passed through the Canal during my recent journeys both to and from Colombo I heard from several residents in those towns that this happy riddance has been maintained by the local sanitary authorities. It is notorious also that several large cities in North and South America (besides the Panama Canal zone) have also been almost entirely freed from the mosquito-plague. The day will come when all well-managed towns and estates in the tropics will get rid of mosquitoes just as they now deal with bugs, lice, and other vermin —not to mention lions and tigers!—and the whole of my advice to Ceylon is to follow these excellent examples as soon as possible.

The other methods for malaria-reduction besides mosquito-control have been tried in Ceylon, but are not very favourably reported upon by Mr. Carter. Coolies and their families can seldom be persuaded to take quinine regularly, except when they have fever; and when I was Consultant in Malaria at the War Office during the war quinine-prophylaxis in Salonika and elsewhere proved to be only a temporary safeguard against malarial fever. Nets and screens, culicifuges, gloves and veils are also impossible for coolies, and are useful only in the absence of proper mosquito-control; and, as I have said, I was not conscious of being bitten in Ceylon, in spite of faulty bed-nets, or often no bed-nets at all. Mr Carter is breeding large numbers of the small fish which eat mosquito larvæ, and he finds them useful in wells. In my opinion, inadequate or unnecessary wells should be filled up altogether as much as possible. There are always great difficulties connected with paddy-fields, which often, though by no means everywhere, breed the dangerous species of mosquitoes: the rice-plots cannot usually be drained away without interfering with private rights and are in different conditions at different seasons, sometimes suitable and sometimes unsuitable for *Anopheles* larvæ. In fact, this point, and the question of borrow-pits, seem to provide the principal problems of *Anopheles*-control in Ceylon. The future is sure to yield improved solutions.

This is not the place for technical details, but mention should be made of " Paris Green," a fine chemical powder, which, when blown on to the surface of a pool, poisons the *Anopheles* larvæ only, as demonstrated in America. A sample given to me by the Colombo Commercial Company was handed over to Mr. Carter for trial; and the number of the *Indian Medical Gazette* already mentioned describes a very encouraging experiment in Bombay with this substance (page 115). The drawback about it is that it does not kill other mosquito larvæ. For a quarter of a century I have urged that search should be made for an *ideal larvicide*, which can be thrown on to pools in the form of small pellets that will float on the surface of the water and destroy all kinds of mosquito larvæ there without injuring crops or cattle—and I hope to recommence the investigation this summer (after previous failures). Recent studies of the relations between larvæ and the hydrogen-ion contents of various waters made by MacGregor, Buxton, and Senior-White (op. cit.) are also very promising—though one suspects that these con-

ditions may affect the food of the larvæ more than the larvæ themselves directly.

Somewhat too much is being made of small differences in the habits of different species of *Anopheles* larvæ. In his selection of waters which require treatment for malaria control, the wise malariologist will look not only on those which breed culpable mosquitoes to-day, but also at those which may do so to-morrow. He will, moreover, try to remember waters which breed mosquitoes that annoy without carrying any infection. He will cast the net of mosquito-control as widely as possible so as to include as many of the insects as he can. The costs may sometimes be a little more, but the results are likely to be far more complete and satisfactory. On the other hand, where the costs are likely to be much more, he will have to think twice over his recommendations: and the conclusion must depend on local conditions.

I was told that the malaria-bearing species of *Anopheles* have not even yet been fully and satisfactorily incriminated in Ceylon by cultivating or finding the malaria-parasites in them. This should be done at an early date. Quite possibly, if not probably, certain local varieties even of known malaria-bearing species of *Anopheles* may be innocent, and vice versa. Strain as well as species is sometimes concerned in the carriage of parasites.

Much annoyance is caused in many estates in Ceylon, as well as in numerous other parts of the world, by minute little black flies commonly called eye flies, which constantly buzz in the eyes and ears, specially in open verandahs during the heat of the day. Very little definite appears to be known about these insects; but from the fact that they abound much more in certain spots than in other places I conjecture that they breed in connection with some kind of plant or tree, or in some other purely local sites. If so, they might be easily diminished or even banished. I suggest, therefore, that the planters might have these flies thoroughly investigated, if possible. They are also supposed to carry inflammation of the eyes, and, in fact, one of my children acquired a most severe attack of conjunctivitis in Bangalore many years ago, probably owing to infection carried by these little creatures.

In conclusion, I hope that malaria-control will shortly become general in Ceylon, as it is now likely to do in parts of the Indian Empire. All the conditions for advance are present there, and only a suitable organization for private estates remains to be established. This, I am sure, will shortly be done.

Current Literature.

THE AMERICAN JOURNAL OF TROPICAL MEDICINE. March, 1926.

Cure of Clonorchiasis by Tartar Emetic (A. C. Reed and H. A. Wyckoff).—The case is described of a Chinese woman, aged 32, who was excluded from landing at San Francisco because of clonorchiasis. Her general history, unimportant; health, good; and physical examination, negative. Slight secondary anæmia. Stools constantly showed the presence of *Clonorchis* and *Trichuris* ova. Six weeks' treatment with neo-arsenobillon and bismuth-potassium tartrate suspended in oil had no action on the *Clonorchis* and *Trichuris* ova in the stools which were constantly present. A course of tartar emetic treatments was begun, using a fresh, clear 1 per cent. solution in doubly distilled water. Intravenous injections of 3 c.c. and 4 c.c. caused very severe local reaction and thrombosis. Intramuscular injections were then tried, consisting of oil containing 1 per cent. novocain and 0·25 grm. tartar emetic per cubic centimetre of oil. This method had to be abandoned on account of intense local reaction and pain. Intravenous use of fresh 1 per cent. tartar emetic in doubly distilled water was again tried; by starting with a smaller quantity, using a fine hypodermic needle and injecting very slowly local reactions were entirely avoided, and the patient was cured five months later.

Amœbic Colitis. Its Treatment by Trans-Duodenal Medication (A. F. R. Andresen).—Each year five or six cases of amœbic colitis are treated at the Long Island College Hospital. Nearly all are of tropical origin, occurring among seamen from foreign ships in the harbour, but an occasional endemic case is seen. The treatment carried out at the hospital has given very encouraging results, and the patient shows great improvement within forty-eight hours. The active amœbæ are protected from destruction by the plugging of the ulcers with debris. This plug can be removed by the trans-duodenal enema. Powdered ipecacuanha, given through the tube, immediately after the ulcers are cleaned out, can get in its effects where most needed. Emetine, given hypodermically, may be a useful adjuvant.

Some Observations on the Tertiary Lesions of Frambœsia Tropica, or Yaws (L. H. Bittner).—The author is convinced that rhinopharyngitis mutilans, keratoma plantare sulcatum, and juxta-articular nodules are all tertiary lesions of frambœsia or yaws. A case is described of each affection. All these conditions are helped by neosalvarsan alone; in the first, the ulcerative processes can be cured; in the second, the painful fissures can be healed and the soreness relieved, while the indurated skin becomes softer; in the third, the nodules are diminished, but do not always disappear. Juxta-articular nodules, if necessary, can always be removed by surgery without recurrence, where neosalvarsan fails to cure.

Experimental Rat-Bite Fever (M. Theiler).—A spirochæte closely resembling the *Spirochæta morsus muris*, was demonstrated in the blood of guinea-pigs and white mice injected with the blood taken from a typical human case of rat-bite fever. White mice and rats are readily infected with the spirochæte. These animals show no symptoms but harbour the organism in the blood for a long time. Guinea-pigs inoculated

with the spirochæte, after an incubation period of six to fifteen days, develop fever, enlargement of the lymph glands, inflammation, and later induration of the external genitals and loss of hair. Rabbits were infected by subcutaneous, intradermal and intratesticular injection of blood containing the spirochætes. About half of the animals used developed no symptoms, but their blood was infective for guinea-pigs for three weeks after inoculation. In the serum of infected rabbits strong spirochæticidal properties are developed.

The Significance of Cholesterol in Tropical Hydrocele (H. M. Stenhouse).—The study of this malady has been carried out at the hospitals of St. Croix, one of the Virgin Islands of the United States, where it is very common. *Filaria bancrofti* infects practically the entire populace. Arteriosclerosis, cataract and elephantiasis are frequently observed and at an early age. The cholesterol crystals found in hydrocele are considered by most authors to be a secondary degenerative product, but Stenhouse states that the very density of the crystals in some fluids is of itself a very strong argument against such a theory. Hydrocele develops approximately in one man in eight in St. Croix. It is especially associated with active sexual life; it affects both sexes and becomes gradually more common as we advance through successive age periods. *Filaria bancrofti* takes first place among factors tending to induce hydrocele. The nature of the occupation and hereditary tendencies must be borne in mind. No particular incident has been found to excite the process. Hard work of body may be a partial antidote against hydrocele.

Occurrence of Anopheles vestitipennis in Porto Rico (H. A. Johnson).—This is the first time that larva or adult male of the species has been found in Porto Rico. The recognized home of the species seems to be Central America, and unless the species has been generally overlooked in the West Indies the finding of *A. vestitipennis* so far away from its natural haunts is of particular scientific interest.

The Influence of Obstacles Unconsciously Erected against Anophelines (Housing and Screening) upon the Incidence of Malaria (M. F. Boyd).—In this survey 504 houses were examined, in which there were 298 cases of malaria, or 11·6 per cent. of the population in that area. Blood smears from 175 individuals showed the presence of *Plasmodium vivax* in fifty-six and *P. falciparum* in twelve. None of the dwellings in the survey area could be classified as mosquito-proof, yet it is seen that a house which may not meet the requirements of so-called mosquito proofing can nevertheless afford its occupants a considerable degree of protection. In places where screening existed it had been done as a fly protection, but had served to render the accessibility of anophelines into the dwellings more difficult. The construction of tight, well-screened houses, actually mosquito-proof, should be encouraged.

Reviews.

REPORT TO THE SECRETARY OF STATE FOR THE COLONIES ON THE OUTBREAK OF PLAGUE IN THE GOLD COAST COLONY AND ASHANTI. By Professor Sir William Simpson, C.M.G., M.D., F.R.C.P., D.P.H. Published by the Crown Agents for the Colonies, 1925.

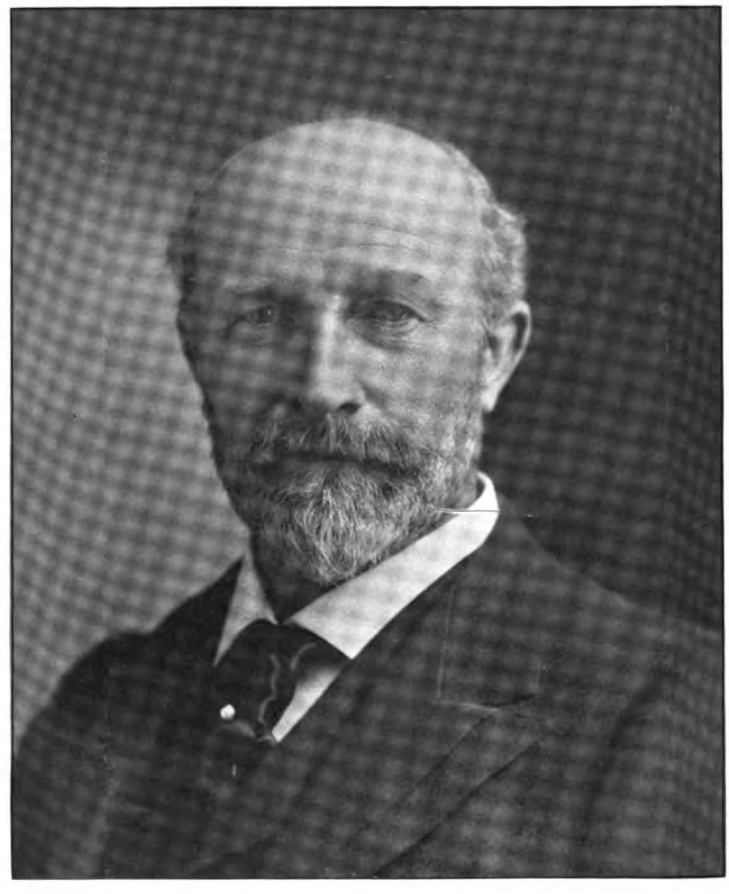
This Report, like all the previous ones presented by Sir William Simpson, is the work of a practised hand. He describes the outbreak of plague which occurred in Seccondee and Coomassie, on the Gold Coast, in 1924, and on the conditions which favoured its prevalence. He points out that until 1924 there had been no serious outbreak of plague on the Gold Coast since 1908, and attributes some of this immunity to the fact that the Gold Coast does not possess any port with a harbour which admits vessels alongside its docks, and thus lessens the danger of importation of the disease by infected rats. The conditions prevailing in Seccondee and Coomassie, which render these towns vulnerable to endemic diseases, are pointed out, together with the measures necessary to prevent further reinforcement from other infected countries. A series of instructive photographs of the conditions encountered complete this excellent report. F. E. T.

THE HEALTH OF THE WORKERS. By Sir Thomas Oliver, M.A., M.D., D.Sc., LL.D., D.C.L., F.R.C.P., Professor of the Principles and Practice of Medicine, University of Durham and College of Medicine, Newcastle-upon-Tyne. London: Faber & Gwyer, Ltd. (The Scientific Press), 1925. Pp. 226. Price 2s. 6d. net.

This small volume constitutes one of the new series of Modern Health Books edited by Professor Fraser Harris, who, in his Introduction to the series states that "every volume has been written, for the benefit of the general public, by a first-rate authority. It is (as it were) a ticket of admission for all and sundry to the marvellous laboratory where science is remaking the modern world." He has certainly succeeded in obtaining a first-rate authority to write on trades as they affect the lives of the workers in Sir Thomas Oliver, who, while avoiding the use of too technical language, has given us an interesting and authoritative, albeit brief, account of the various medical and social problems connected with industrial occupations. F. E. T.

LOCALIZZAZIONE DEI CENTRI CORTICALI PER MOVIMENTI LARINGEI. Luigi Bellucci, Siena, S. Bernardino.

This study of the localization of the cortical centres for laryngeal movements constitutes a handsome monograph of 294 pages, with many charts illustrations, and an extensive bibliography. It is divided into three parts dealing with historical and literary, experimental and anatomico-pathological and clinical data respectively, together with a summary of general considerations and conclusions. It should prove of great value to those interested in this special subject. F. E. T.



SIR JAMES CANTLIE.

K.B.E., M.A., M.B., C.M., LL.D. F R.C.S., D.P.H.

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Obituary.

JAMES CANTLIE, K.B.E., M.A., M.B., C.M., LL.D.Aberd., F.R.C.S.Eng., D.P.H.Lond., was born in Banffshire, on the Fiddoch, a tributary of the lower Spey, in 1851. In the University of Aberdeen he graduated with honours in Arts, and with honours in Surgery after completing his medical education at Charing Cross Hospital. From this he also took the F.R.C.S., and here he served the various house appointments. A little later we find him Demonstrator of Anatomy, and presently Assistant Surgeon. In these appointments he laid the foundation of his name as a tutor, coaching a succession of candidates who took the highest places in the Examinations for the Public Services. A short visit to German Universities and service in Egypt in the Cholera Outbreak Commission of 1882, as one of "the twelve apostles," were pleasant breaks in his hospital work.

It was in those early days that Cantlie was in a quite casual way introduced to one of the chief interests and occupations of his life—ambulance—by circumstances, almost dramatic, known only to his personal friends. He happened to be asked, through me, to lend a hand in editing the first edition of a *Manual on First Aid to the Injured* being drawn up for the St. John Ambulance Association by my friend, Surgeon Major Peter Shepherd, who was suddenly ordered to the front in Zululand and had to leave the book unfinished. Shepherd fell in Isandhlwana. Cantlie threw himself with all his heart into application of the principles and methods of ambulance to the circumstances and necessities of civil, as adopted in military, life; became associated with the Order of St. John as a Divisional Surgeon; and set out to improve and extend public provisions against accidents and other untoward events by training not only railway servants and factory hands—male and female—but the general population, in the elements of anatomy and of First Aid to the sick and wounded. It was work fated to be of service to his country in war as well as in peace. This was his first step in the direction of public work of this kind.

A second step was momentous; and Cantlie's credit for the issue of it must not be forgotten. He determined to introduce ambulance drill in the Volunteer Medical Service where he was serving as Surgeon to the London Scottish. He made light of criticism, called for volunteers from his students at Charing Cross, drilled them, and—braving authority—had the courage to ask and the good fortune to secure the consent of Lord Wolseley to inspect his little company when he came to distribute the prizes at the Medical School in 1883. His devices to bring together the volunteer students of the different London hospitals by furnishing the Corps with uniform and a band, although fitting material for a comedy, led to success. He next took his men to a field-day. No official protest was made; and in due course the new Corps was recognized. Cantlie had "raised" the Volunteer Medical Staff Corps, destined to become the R.A.M.C.(T.F.), and to be of priceless service in the war, and with much other good work to be rewarded with the rank of Lieutenant-Colonel and a Knighthood.

The year 1887 found him making a complete break in his career as a Surgeon and Teacher in a London hospital, and in his active work, but not his interest, in ambulance. Manson asked me to send him a partner in his practice at Hong Kong, and Cantlie went out. There he spent nine years of busy life. But medical and surgical work was only part of his occupation. He accomplished a third achievement: he found time to lay the foundation of a University. Notwithstanding Manson's hesitation, Cantlie yielded to the desire to teach which always possessed him, and opened a School of Anatomy and Elementary Surgery for young Chinamen, who were to carry from Hong Kong to their ignorant fellow-countrymen in the mainland the learning and methods of the West. The school flourished and developed into the College of Medicine for the Chinese, which is now one part only of the University of Hong Kong with its three Faculties. Its first pupils were less fortunate. It was reported that when they reached their native parts they were seized and executed as rebels. —All but one, who escaped back to Hong Kong and safety, Sun Yat Sen, fated to meet his teacher years later in London and to be rescued by him from imprisonment in the Chinese Embassy and prospective deportation and death, and destined to be President of the Chinese Republic!

On his return to London in 1896 Cantlie readily established himself in practice as a first-hand authority in tropical diseases—one who had studied and treated them in their natural climate. He secured the appointments of Surgeon to the Seamen's Hospital at the Docks and Plague Officer to the L.C.C. He founded and edited this *Journal*; and in it, and generally, took an active part in bringing home to the Government and the City the vital importance of a training in tropical pathology and tropical medicine to our imperial trade and to the nation. In due course we find him Lecturer in the London School of Tropical Medicine and President of the Royal Society of Tropical Medicine.

All these interests did not serve to distract him from ambulance work. On the contrary, he served in it more widely and intensively than before. He attached himself to the two great organizations for ambulance service—St. John and the Red Cross—giving much time to lecturing and practical training in it at different centres; and thenceforward he never forsook ambulance as an interest and a concern conducted side by side with practice in tropical medicine. It was at this stage that he

came to be more and more sought after as the leading teacher of the general population in First Aid, and as widely known by the public as in the profession, rising to the distinctions of Assistant Commissioner of St. John Ambulance Brigade and a Knight of Grace of the Order of St. John of Jerusalem. He was elected a member of the British Red Cross Society, for which he wrote three manuals—on *First Aid*, *Nursing* and *Camp Life and Drill*. The need and value of all this was to be recognized presently; in the war hundreds of pupils passed through his hands, women especially qualifying as V.A.D.'s.

Some of Cantlie's friends have found it difficult to account for his pursuit of interests of this kind—popular lecturing and ambulance drill—in which a rising hospital surgeon and teacher came to interest himself permanently in ambulance and First Aid, outside the ordinary line of professional work. As I knew him from his youth, I recognized that he was naturally an uncommonly acute observer and critic of men and things; and as the range of his observation widened in and after life abroad he was constantly finding something that he considered should be improved, some public want. Hence many of the events of his restless life at Hong Kong and at this time, which brought him credit; hence, also, many notions and schemes which met with criticism and did not mature. With this critical inventive disposition there were united in Cantlie other qualities determining the course that he took. He was impulsive in his projects, making light of difficulties—at any rate he disregarded them, indifferent to criticism, no doubt ambitious. This independent spirit of his, acting on strong convictions, too often led him to consider only the object he had in view, regardless of cost. Other men might have spared neither time nor money for the public good in these circumstances, nor did he; but who but Cantlie would have sacrificed so far professional practice and professional advancement in such a cause as the pursuit of First Aid and ambulance? All the more honour to him! It was for the public good; and through much questioning and discouragement he lived to have his labours recognized by King and Country.

Cantlie's three real triumphs by which he will always be remembered were the training of hundreds of V.A.D.'s in the war, the "raising" of the V.M.S.C.—to develop into the R.A.M.C.(T.F.), and the foundation of the College of Medicine for the Chinese. Of smaller, but still of much account, were his provision of a portable X-ray apparatus for the poor in country places, and his scheme for qualifying in First Aid all youths proceeding to business abroad. Of his other original notions one remembers a proposal to bring fresh air into London from Brighton by means of underground tubes; to abolish the Eton jacket in boys because of the unwise exposure of the renal regions: his suggestion that appendicitis may arise in "piles of the appendix" from congestion of the remote roots of the portal system in the ileo-colic veins; and his views on the degeneration of Londoners and the disappearance of their third generation.

Personally, Cantlie presented a hearty, honest, bright manner, expressive of his independent, confident spirit as we have described it. The most cheerful of companions, he had no match in amusing people of all ages. He would nurse an infant for an hour on end, give it its bottle, and finish the contents himself. Men of his own years he entertained with song and story, mostly in broad Scots, rendered with appropriate gesture. He was "guest of the evening" at medical dinners in all parts of the country. There and on platforms he was in his element, and a real artist in oratory of this kind. He preached the sermon on Hospital Sunday in St. Martin's Church, Trafalgar Square. He addressed a Jewish gathering on Moses and Hygiene, with particular relation to plague. And indeed, quite apart from these casual functions, he had no equal of his time as a lecturer and demonstrator—ready, striking, attractive and always interesting and amusing, noted for many sayings which no pupil could forget. Our readers know that he was equally so in his writing which was his other chief pleasure.

Cantlie's health and strength began to give way many months before the end, which mercifully came without distress of any kind. His four sons, whom he educated with judgment, are left respectively in positions of public importance. His wife, his guide and mainstay, died a few years ago leaving him "a different man."

Cantlie's life, when we survey it at its end, in the same generous, kindly spirit which was his own, is seen to have been a life of service to his country—so distinguished in its aims, in its attainments, and as an example, as to be worthy of permanent record in our national history.

J. Mitchell Bruce.

Syphilitic Alopecia: Its Relation to Neurosyphilis (U. J. Wile and G. H. Belote, *Archives of Dermatology and Syphilology*, April 1926).—Syphilitic alopecia of the essential type has a high associated incidence of meningeal syphilis, as indicated by spinal fluid findings. The absence of the accepted criteria in the spinal fluid cannot, moreover, be accepted as absolute evidence of the absence of such involvement. Microscopic study shows that the essential syphilitic alopecia is not due to any local pathologic disturbance of the scalp, or, more specifically, of the follicular apparatus. It is therefore not a true syphilide. Clinical analogy affords the suggestion that it is due to the action of the endocrines on the nervous system. Symptomatic alopecia representing a smaller group of the entire syndrome is a true syphilide, apparently caused by a perifollicular plasmoma.

Original Communication.

THE INFLUENCE OF AN ACID REACTION ON THE VIRUS OF THE CHICKEN SARCOMA (ROUS) AND ITS IMPORTANCE IN THE EXPERIMENTS OF DR. GYE.

By E. Harde, M.D.

In the last few years numerous articles have appeared on the acid reaction of normal and pathological tissues. This acidity has been found in normal active adult tissues, in all embryonic tissues, in inflammatory reactions, in cultures of tissues *in vitro* where the cells are in a state of division, and also in dead and autolysing cells. The importance of this reaction is probably great, but it is not yet completely elucidated.

At the present time I am studying the influence of acidity on the origin and development of certain neoplasms of chickens and of mammals. In this preliminary note I will give the résumé of certain experiments with the virus of the chicken sarcoma (Rous No. 1).

Rous and his collaborators have established the following facts in their classical studies on this sarcoma. They have shown that this tumour is transmissible by inoculation of a filtrate and that within certain limits there is a definite relation between the size of the dose inoculated and the time of appearance and of the development of the tumour. There exists a minimum dose, the injection of which produces a tumour; a smaller quantity will produce no tumour, even though it contains the virus. It is in effect a subtumoral dose. Multiplying the dose increases the activity of the virus, to a certain extent. Here, also, there exists a limit beyond which further increase of the virus produces no further increase of virulence. Rous has also found that with a tumour of low virulence, injection of small doses or of the filtrate may be followed by a tumour which appears only after the elapse of some weeks, develops slowly for a time, and then regresses. The virus with which I worked is not very virulent. Chickens live five to eight weeks after being inoculated with the grafts.

With these facts so definitely proven, I am able to study the influence that acidity may have on this virus. 1 to 2 grm. of a chicken sarcoma were ground up, mixed with physiological salt solution or Ringer's solution, and filtered through sand and paper pulp. This filtrate was neutral or slightly alkaline. I divided it in two parts, the first was left neutral, the other part was acidified with an acid salt KH_2PO_4 to a pH 5·5. An equal dose of each of these solutions was injected into the pectoral muscles of a chicken, one dose in the right side, the other in the left.

On the side of the acid injection a tumour appeared within twelve days and invaded the entire pectoral muscles, whilst following the control neutral injection there was a small tumour three weeks later, which developed very slowly, and at the death of the chicken was only 2 to 3 centimetres in size.

In this experiment the slow apparition of the tumour, its limited growth produced on the control injection, neutral solution, shows it to be a dose of the virus at its lower limit. The addition of a small quantity of an acid salt is sufficient to activate this minimum tumoral dose so that it acts as a multiple dose. As we have said before, Rous showed that the rapidity of appearance and development of this sarcoma is proportional to the dose or virulence of the virus.

With a multiple dose of the virus the tumour produced by the acidified filtrate has been twice as large as that caused by the control injection in neutral solution. Here, also there is a definite increase of virulence. There is, however, a point at which lowering the pH no longer produces an effect: that is to a very virulent or multiple dose. This is again in accord with Rous's findings, that the action of the virus cannot be increased beyond a certain limit.

In other experiments the quantity of the virus was diminished, until the control neutral injection was not active and the acidified filtrate caused a small tumour, which appeared late and regressed.

Further, I have found that too great an acidity is harmful to the virus. Single control injections of a solution of acid salt alone produced no tumour. The action of repeated injections is now being studied.

Discussion.

The above experiments have clearly shown that the virulence of a filtrate of chicken sarcoma can be changed—increased or diminished by the addition of a variable quantity of an acid salt—the monopotassium phosphate. Since by an appropriate acidification the virulence of the filtrate may be considerably increased, it is of interest to examine Dr. Gye's experiments on the chicken sarcoma.

His work has been reviewed so extensively that I will only give a brief résumé. First, however, I desire to call attention to one fundamental fact. In every experiment in which Gye finds increased virulence, acidity has been added. Whenever he mixes his two factors, one of those factors is always acid, whether it be a "culture" it is acid, or whether it be the superficial layer of a centrifuged liquid, it also is acid. Gye neglects this acidification completely, since all his control injections (which prove but slightly active or non-virulent) are made with the solutions of neutral or alkaline reaction.

Gye considers that two factors are necessary for the production of tumours—one non-specific, which he considers to be almost certainly a virus; the other, the specific adjuvant, which determines the nature of the tumour. The first factor injected alone is not virulent. Gye thinks he has proved that it exists separately in old non-virulent primary cultures and in subcultures of chicken sarcoma, in

cultures of various other tumours and in the non-active washed deposit—obtained after centrifuging a primary culture or an acidified filtrate. The second factor, the specific adjuvant, Gye finds in the chloroformed filtrate of the chicken sarcoma or in the supernatant fluid after centrifuging an acidified filtrate or a primary culture. This factor injected separately is but slightly active or not at all. Gye bases his hypothesis on this separation of the two factors necessary for the formation of a tumour, a separation which he obtains either by the use of the centrifuge or by the use of chloroform and by his so-called "cultures" of the virus of neoplasms.

Let us examine the simplest series. Gye centrifuges a filtrate acidified by the addition of monosodium phosphate. The supernatant fluid is slightly if at all virulent, whilst the deposit is active. He washes the deposit twice with salt solution. The final emulsion in a neutral solution is inactive at a certain dose. He renders it virulent by adding the supernatant fluid, which is acidified by the NaH_2PO_4 (mixing half the dose of each solution when injected separately). It scarcely seems necessary to introduce a specific adjuvant in this experiment when one takes into consideration the work I have just reported. Gye, himself, says the virus is contained in the washed deposit. It seems to be a subtumoral dose in a solution of neutral reaction which is activated not by the addition of a specific adjuvant, but simply by the addition of a solution of an acid salt containing a small quantity of virus. The centrifuge has not completely removed the virus from the supernatant fluid, since frequently Gye finds that when injected alone it causes a small tumour. The other experiments are more complicated. Gye inactivates a filtrate with chloroform (as shown by Rous and his collaborators). He injects:

1. **Two doses of the chloroformed filtrate.**
2. **Two doses of a subculture of the filtrate always inactive—always acid.**
3. **A mixture of one dose of No. 1 and one dose of No. 2.**

The result depends upon the quantity of chloroform used; with a certain dose of chloroform the treated filtrate no longer produces a tumour, but it is activated by the addition of a subculture which is always acid in reaction.

Gye remarks that if he does not use sufficient chloroform the treated filtrate alone may produce a sarcoma, but if he adds too much chloroform, the virus is definitely inactivated, not even the addition of a subculture will activate it. Gye uses for his "cultures" of the virus of neoplasms a special KCl glucose bouillon to which is added rabbit serum, and a large quantity of tissue. His primary cultures of the chicken sarcoma contain 1 to 2 grm. of the tumour to 6 c.c. of fluid incubated anaerobically. In the subcultures he substitutes chick embryo for the chicken sarcoma. Not only has he activated the chloroformed filtrate with subcultures of the chicken sarcoma, but also with cultures of the virus from diverse mammalian tumours. Because of lack of control experiments published, his work has always been open to an entirely different interpretation. The recent experiments of Murphy on this very point have definitely confirmed this opposing view. Gye gives no control work by activating the virus with "cultures" of embryonic tissue alone. Murphy activates a chloroformed filtrate with a "culture" of chick embryo or of mouse placenta, and obtains results which duplicate exactly Gye's work with so-called "cultures" of the virus of neoplasma. Concerning Gye's specific adjuvant in these experiments it is a chloroformed filtrate partially inactivated and rendered virulent by the addition of "cultures." Gye finds that his cultures are very acid. Murphy states that the embryonic tissue or mouse placenta were selected for the control "cultures" because they share with malignant tissue the ability to utilize sugar in their metabolism under anaerobic conditions, and Murphy adds "this seemed important in view of the possibility that the substance activating the chloroform treated filtrate might be a product of metabolism." Murphy does not give the reaction of his "cultures" of placenta or chick embryo, but as the sugar has been utilized the reaction is certainly acid.

Therefore in this series of experiments also the acidity undoubtedly is of importance in the activation of the chloroformed filtrate, but here it is possibly associated with other factors extracted from the embryonic tissue.

Résumé and Conclusions.

An acid reaction is formed in many active tissues, both in the vegetable and animal kingdoms, in normal and in pathological conditions. It is not yet completely understood. Many observations exist which suggest that it plays an important rôle. I will quote but a few facts, which bear on tumour formation.

Erwin Smith discovered that tumours of many species of plants are caused by a bacillus (*Bacillus tumefaciens*). Smith and his collaborators think that the bacillus acts indirectly by the formation of lactic acid. Recently this theory has found support in the experiments of Blumenthal and Meyer. These authors have produced typical tumours on slices of carrots by the use of lactic acid. Experiments on tissues of the animal kingdom are, unfortunately, more complicated. If this reaction stimulates the division of cells, one can attribute to it a considerable importance in the origin of tumours. Neoplasms are always preceded by chronic irritation, causing death of cells and a resultant local acidity. Rhodenburg has developed a theory of the ætiology of tumours partially based on this fact. The question can be studied from other directions, the possibility of changing the reaction of tumour tissue and the effect such a variation might produce. We are at present working on these lines.

In this preliminary report I have been able to

show the influence of an acid reaction on the virulence of the chicken sarcoma and that an appropriate acidity increases the virulence of this virus. Gye has neglected this factor completely in his work, never having controlled it. But each time he was able to show an activation of the virus, acidity was added, whilst the non-active control injections were always in neutral or slightly alkaline solutions.

The recent work of Murphy on control "cultures" of chick embryo and the present experiments on increase of virulence by addition of acidity explain in a simple manner Gye's experiments, an explanation in which neither his two factors nor his supposed "cultures" of the virus of neoplasms is necessary or proven.

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Annotations.

Changes in Respiration, in Circulation and in the Coagulation Time of Blood Produced by Sodium Citrate Injections (M. Joannides, *Archives of Internal Medicine*, February 15, 1926).—Studies on man and the dog show that injections of sodium citrate do not usually increase the coagulability of the blood. Intramuscular injections are less dangerous than intravenous injections. A 3 per cent. solution of sodium citrate which is isotonic with blood has been fairly well tolerated by a patient who received from 300 to 450 c.c. intravenously. This practice, however, should be discouraged. Intravenous injections of great concentrations of sodium citrate are dangerous because they cause immediate respiratory and circulatory collapse. Calcium chloride given promptly during the height of toxic symptoms may save the animal from death. But calcium chloride itself is a dangerous drug if injected intravenously in large doses. The toxic symptoms must in some way be associated with changes that concern the coagulation of the blood, because the latter becomes incoagulable under these conditions. As soon as the toxic symptoms subside the coagulation time of the blood becomes normal. Shallow, slow breathing, a rapid and later slow pulse-rate, convulsions, at times salivation and incontinence of urine, with a drop in the systolic pressure and increased coagulation time, mark the presence of toxic effects of sodium citrate. Small repeated hæmorrhages, apparently, have no effect on the coagulation time. On the other hand, when larger amounts of blood are removed they cause increased coagulability of the blood. Citrated blood transfusion under such conditions increases the coagulability of the blood still more. There is no apparent difference in the coagulation time of the arterial and of the venous blood. Injections of 0·2 per cent. sodium citrate solution in 0·75 per cent. sodium chloride solution invariably decrease the coagulation time of the blood and do not cause toxic symptoms if the citrate dose is within the subtoxic limits. Sodium citrate apparently disappears from the blood-stream promptly since the toxic symptoms produced by the salt disappear quite promptly. Sodium citrate used in amounts corresponding to those for blood transfusion is a useful drug. In larger amounts or concentrations it is a dangerous drug.

Intramuscular Absorption of Some Insoluble Bismuth Compounds as Revealed by the Roentgen Ray (H. N. Cole, H. L. Farmer, and H. Miskdjian, *Archives of Dermatology and Syphilology*, February, 1926).—A study of cases in which patients received injections with certain bismuth salts deep into the lumbar muscles gives the following data. Finely divided metallic bismuth was unabsorbed in extremes of 44 to 150 days and a median of 143 days. No case of absorption was observed. Bismuth oleate was unabsorbed in extremes of 12 to 68 days and a median of 26 days. No case of absorption was observed. In two observations, no absorption of oxybenzoic acid compound of bismuth was noted after 40 and 44 days respectively. In only ten of forty-four injections of bismuth salicylate was complete absorption noted in a median of plus 45 days, while the injections were still unabsorbed in thirty-four instances with extremes of 14 and 124 days and a median of 30 days. In twenty-two of twenty-nine injections of potassium bismuth tartrate total absorption was noted in a median of 14 days and extremes of 6 to 27 days, while it was unabsorbed in seven injections in extremes of 14 to 39 days and a median of 24 days. These findings indicate that injections of metallic bismuth are dangerous, and, if persisted in, will lead to cumulative absorption and possibly even to fatal results. The same is probably true, although to a less extent, of bismuth oleate. Bismuth salicylate likewise possesses this objection and its use should be replaced by one of the more soluble bismuth salts—perhaps the potassium bismuth tartrate preparations. These salts, especially if injected intragluteally once a week, are probably not so likely to give rise to cumulative action. However, the patient should be observed

closely, as even this salt is not above criticism, so far as its absorption is concerned. The contention that insoluble bismuth salts must be injected twice a week is open to question, as only a small amount of the salt will be absorbed at the most. Moreover, too frequent deposits may lead to cumulative action, toxic symptoms and even the death of the patient.

Treatment of Neurosyphilis with Tryparsamide (P. A. O'Leary and S. W. Becker, *Medical Journal and Record*, March 3, 1926).—The use of tryparsamide at the Mayo Clinic, extending over a period of three years, in 207 cases, leads to the belief that although its use is still in the experimental phase, tryparsamide is of value in the treatment of the paretic type of parenchymatous neurosyphilis. It does not seem to offer as much encouragement as the treatment of general paresis with malaria, but it is available for those not suited to the risk of the latter treatment. Evidence, based on subjective and serological improvement, justifies the assertion that there is a certain small group of patients with paresis who derive marked benefits from tryparsamide. In seven cases in the whole series there was a complete reversal of the spinal fluid findings to normal, but no associated clinical improvement. The authors were unable to ascertain the clinical and serological criteria by which to determine beforehand the patients with paresis who will improve. The objective visual complications offer a hazard (4·3 per cent.) which could not be prevented by special precautions. The mechanism of this complication has not as yet been described. The use of bismuth intramuscularly in conjunction with tryparsamide seems to offer better therapeutic results than either given alone. The low cost, availability, and small percentage of complications and reactions are among the advantages of the drug. The continued clinical use of tryparsamide may eventually determine the niche in the armamentarium of neurosyphilitic treatment in which it is to give the most encouraging results, but until that time its use is warranted as a valuable adjunct in the treatment of the patient early in the course of general paresis.

Dengue. Its History, Epidemiology, Mechanism of Transmission, Ætiology, Clinical Manifestations, Immunity and Prevention (J. F. Siler, M. W. Hall and A. P. Hitchens, *The Philippine Journal of Science*, January-February, 1926).—This paper is the only one in the volume of 304 pages. The summary is as follows: Dengue and yellow fever are transmitted by the same species of mosquito (*Ædes ægypti*) and the mechanism of transmission for both diseases is strikingly similar. Epidemics of both dengue and yellow fever are therefore subject to the same control measures. The control of epidemics of dengue usually is accomplished by a material reduction in the mosquito population of the community. The mechanism of transmission briefly is as follows: The dengue patient infects mosquitoes during the first three days of illness; the infected mosquito is able to transmit the virus eleven days after its infection; infected mosquitoes remain infective throughout life; hereditary transmission of the virus does not occur. Epidemics of dengue can occur only when there are simultaneously present cases of dengue fever, large numbers of *A. ægypti*, and large numbers of non-immune individuals.

A. ægypti control campaigns must be based upon a consideration of its life habits; it is one of the most highly domesticated of mosquitoes; it apparently does not hibernate; it disappears when the atmospheric temperature falls appreciably below 59° F. and remains there for any great length of time; it prefers to take blood from man; it is essentially a day-biter, but may take blood at night; its average length of life, under natural conditions, is probably not more than six weeks; it breeds by preference inside human habitations and on the premises thereof; it practically always deposits its eggs in collections of clear water; its eggs, being very resistant to an unfavourable environment, retain their vitality after storage in a dry place for several months; the eggs hatch normally in three days and the adult (free-flying stage) emerges ordinarily from eight to fifteen days later.

Dengue preventive measures are based on two lines of attack, namely, co-operative effort on the part of individuals, both sick and well, and organized mosquito control campaigns on the part of the public health authorities. Co-operative effort on the part of individuals should include the following factors: Patients should protect themselves from the bite of *A. ægypti* mosquitoes during the first three days of their illness; mosquito nets should be used at night and during afternoon siestas; non-immune persons should avoid homes in which secondary cases of dengue occur; householders should destroy adult mosquitoes observed within the house; water should not be permitted to stand in uncovered receptacles in the house or on the premises for a longer period than seven days. Consideration should be given to a number of factors preparatory to the formulation of the plan of campaign. If dengue has been endemic for a long period, many of the natives will have acquired more or less immunity, and epidemics usually are confined to the newly arrived non-immune foreigner from areas where dengue is not endemic. If the rate of flow of the non-immune population is small, extensive outbreaks are not likely to occur, and vice versa. In areas of endemicity maps should be prepared showing the following data: Residential sections of the major part of the foreign non-immune element of population; the parts of the city in which a permanent type of construction for buildings predominates as distinguished from construction of a temporary character. Charts showing daily rainfall, humidity and temperature should be plotted. During certain seasons of the year the rainfall will be so low and

may evaporate so rapidly that it would be impossible for *A. ægypti* mosquitoes to breed out in casual rain-water containers. During such seasons and under such conditions, inspection for breeding places should be concentrated on the other natural breeding places of *A. ægypti*. Temperature conditions influence the seasonal distribution of dengue, and in localities in which the temperature falls below 50° F. and remains there for a considerable period of time, epidemics of dengue will necessarily end with the advent of cold weather.

In carrying out anti-mosquito campaigns the principal line of attack should be eradication of the breeding places (antilarval measures), but this should be supplemented by co-operative efforts on the part of the individual. The active interest and support of a moderate proportion of the population can be secured if adequate publicity of an educational nature is carried out. The area to be covered should be divided into districts and adequate and competently trained personnel assigned to each district as inspectors. Inspection should be made at intervals of not more than seven days, and weekly reports relating to breeding places detected should be submitted and consolidated in order that the effectiveness of the work may be evaluated.

Rectal Injections of Quinine (W. Fletcher, *Bulletins from the Institute for Medical Research, Federated Malay States*, No. 1 of 1924).—In the year 1923 an account was published of the unsatisfactory results which follow rectal injections of quinine, and of the pain and tenesmus which they sometimes cause. These conclusions were greatly at variance with established opinion and, in consequence, the Medical Research Council and the Medical and Sanitary Advisory Committee of the Colonial Office asked that further investigations should be made. First, injections were given to guinea-pigs. These were returned too quickly to allow satisfactory absorption of quinine to take place. Secondly, a series of rectal injections were given, two each day for at least six days, to a couple of groups of men infected with malaria. The first group, consisting of ten patients, received 20 gr. of quinine bihydrochloride, dissolved in 4 oz. salt solution, at each injection. The second group, which comprised six men, received the same quantity of quinine, but it was dissolved in 8 oz. of saline, instead of 4 oz. In the first group, out of seventy-one injections, sixty-two were returned during the first twenty minutes; none was retained permanently; the average time of retention was thirteen minutes. Quinine was found in the urine after only thirty-six out of 132 injections. In the second group, out of thirty-two injections in which the time was noted, three were retained permanently and the average time of retention, for the remaining twenty-nine was seventeen minutes. Twenty-five were returned within twenty minutes. Quinine was found in the urine after thirty-three out of fifty-seven injections. In many of the cases where quinine was present the amount was very small. When 10 gr. twice a day were given by mouth instead of 20 gr. by the rectum, abundant quinine appeared in the urine. In eleven out of the sixteen cases of malaria in the two groups, 40 gr. of quinine bihydrochloride, given daily per rectum, failed to get rid of asexual parasites within a week. Quinine was then administered to these patients by the mouth, with the result that the parasites quickly disappeared. Rectal injections, containing 2½ gr. and 5 gr. to the ounce, were given to a healthy European but he was unable to retain them for more than ten or fifteen minutes, and the absorption from 60 gr. injected into the rectum appeared to be inferior to the absorption from 2½ gr. given by the mouth. The presence of mucous and membranous shreds, passed by patients undergoing treatment with rectal injections of quinine, demonstrates the irritating action of the drug upon the mucous membrane.

Medical Research in China (E. V. Cowdry, *Science*, October 23, 1925).—Attention is called to the noteworthy feature of the contributions, namely, to the co-operation of foreigners and Chinese. It is naturally chiefly a matter of the teacher working side by side with his Chinese student, although some of the more mature Chinese have already made important discoveries alone. It is hoped that in the years to come the tendency to work together, once happily initiated, will continue. It is confidently believed that when experienced and fully trained Chinese and foreigners will join hands in united effort, fortified as they are by their peculiar heritages and intellectual endowments, a new force will be brought into medicine, and that mysteries will give way which have long baffled the best minds of England, France and Germany, indeed, of all the nations of the west labouring alone. That this new combination should act in one of the greatest of oriental cities, in an environment rich in intellectual and artistic achievement and altogether different in character from that which has fostered the advancement of science along certain lines in the west, is another factor which may be productive of surprising results. The future is full of promise, and there is a chance that the Pekin Union Medical College may contribute, as few other institutions are privileged to do, towards the purpose of the Rockefeller Foundation, namely, "the welfare of mankind throughout the world."

Important Features in the Correct Diagnosis of Dysentery in India (J. A. Manifold, *Journal Royal Army Medical Corps*, February, 1926).—The summary of this interesting article is as follows: In Poona, at least among the military population, bacillary dysentery, usually mild, is much more prevalent than amœbic dysentery. This finding

agrees with the finding of Majors Acton and Knowles, and of Major Cunningham, working in other parts of India. The paucity of bacillary cases recorded in the past is due to (*a*) many bacillary cases having been erroneously diagnosed as amœbic in origin. (*b*) Owing to the mildness of the symptoms of the cases, many having been diagnosed diarrhœa, colitis, &c., in lieu of dysentery.

The cause of these errors has been: (*a*) Lack of recognition of the character and importance of the cellular exudate in bacillary dysentery, and the diagnosis of macrophage endothelial cells containing red blood-corpuscles as *E. histolytica*. (*b*) Lack of co-operation between medical officers in charge of cases and laboratories.

The result of these errors is that medical officers have believed most intestinal disorders to be due to infection by *E. histolytica*, and emetine has thus become an unnecessarily prominent feature in the treatment of these disorders.

The remedy can be obtained: (*a*) By increased co-operation between clinicians and the laboratory. (*b*) By the D.A.D.P. instructing medical officers in the preliminary precautions that are necessary to establish a correct diagnosis. (*c*) By laboratory workers without recent training (and even those with training only after a large experience) not accepting a cell as *E. histolytica* in the blood and mucus from a case of *acute dysentery* unless it contains red cells and is actively motile. (If non-motile, a worker with large experience might make a specific diagnosis after employing Heidenhain's iron hæmatoxylin stain, not otherwise.) (*d*) By the D.A.D.P. accepting no diagnosis from a subordinate until he has confirmed it himself.

Studies and Observations on Soil Infestation with Hookworm in Southern Alabama from October, 1923, to September, 1924 (D. L. Augustine, *American Journal of Hygiene*, March, 1926).—A study was made in Covington County, South Alabama, on the development and length of life of hookworm larvæ throughout the year 1923-1924. Soils from polluted areas around rural schools and private homes were not found to contain infective hookworm larvæ later than December 27. No infective hookworm larvæ were isolated from polluted soils from December 27 to March 3. Reinfestation was encountered after March 3, which increased in intensity with the approach of the summer months. The failure of hookworm ova to develop into the infective stage during the winter months in Alabama may be attributed to the frequent frosts and low temperatures of that season. Frequent dry periods during the spring were found to check hookworm development entirely. Soil infestation about the houses was usually found to be of less than one month's duration during the summer months. The early death of hookworm larvæ may be ascribed to the rapid drying of the sandy soils. A series of field experiments demonstrate: (*a*) That only a few hookworm ova develop embryos during the winter months. (*b*) That hookworm ova may appear viable for longer than one month at the winter temperature of South Alabama, but fail to develop into the infective stage, when placed under favourable conditions. (*c*) That a high mortality occurs among young hookworm larvæ, even under favourable conditions in nature.

Hookworm Infestation and Re-infestation in Ceylon. A Study of High Incidence with a Moderate Degree of Infestation (J. F. Docherty, *American Journal of Hygiene*, March, 1926).—Over 20,000 egg counts have been made in Ceylon by the dilution egg-counting method, most of which are analysed in this report. Accepting the villagers' statements as to treatments received, the percentage of the original infestation retained at the close of a campaign, after one and two treatments with carbon tetrachloride or a carbon tetrachloride-chenopodium mixture, was 40·5 per cent. and 24·8 per cent. respectively. Infestation in the Western Province is dependent on the age of the individual. The value of mass treatment, at frequent intervals, receives strong support, for Ceylon, as evidenced by the amount of hookworm infestation that rapidly returns after intensive campaigns. The amount of infestation is much greater in estates than in neighbouring villages with the same altitude and rainfall. Average egg count data per person give evidence of a greater amount of infestation in regions of highest rainfall when altitudes are approximately alike. They also give evidence of a decreased amount of infestation with an increase in altitude in districts with the same rainfall.

The Relation of the Type of Soils of Alabama to the Distribution of Hookworm Disease (D. L. Augustine and W. G. Smillie, *American Journal of Hygiene*, March, 1926).—Laboratory experiments and infection surveys were made to determine the relation of types of soils of Alabama to the distribution of hookworm disease. An account is given of the probable introduction of hookworm into Alabama with a review of its distribution at the time of the original hookworm surveys made by the Rockefeller Sanitary Commission. An intensive study was made on the different types of soils of Alabama to determine their effectiveness in producing mature hookworm larvæ. Hookworm cultures in the sandy soils were found to give quite uniform yields of mature hookworm larvæ. It appears that the sandy soils of Alabama have an average value of about 43 per cent. Hookworm cultures in the clay soils gave varying yields of mature hookworm larvæ, from 0·006 to 12 per cent. Below 6, yields of different percentages were equally frequent. Their average value was about 5 per cent. The degree of efficiency of soils, tested as media for hookworm cultures, was found to be directly related to their textures, viz., a physical

property. Hookworm surveys on children from different parts of Alabama showed that the incidence of infestation is greatest in the two sandy provinces, the Upper and Lower Coastal Plains, and that hookworm disease is largely limited to the Lower Coastal Plain. The greater severity of hookworm infestations in the Lower Coastal Plain is attributed to the wide extent of that province and its geographic position in relation to the soil provinces of finer textured soils. Light infestations were constantly encountered among children who had lived all or nearly all their lives in soil provinces in which fine, heavy clay soils predominate, but in no instance did these children have heavy infestations. It is recommended that health officers in the hookworm belt determine, by culture methods, whether the soil predominating in their communities or general districts is favourable or unfavourable for hookworm development.

A New Application for Varicose Ulcers (R. H. Davis, M.D., *Archives of Dermatology and Syphilology*, April, 1926). The fifteen cases reported illustrate results in most patients who were faithful in attendance over a long enough period to give the treatment a fair trial. The whole series numbered fifty-five, but some of these patients disappeared from observation before permanent improvement could be expected. The cases were all ambulatory, with one exception, and many of them of long standing. The application consists of boracic acid, 63 grm., potassium hydroxide (stick), 28 grm., water 200 c.c. A complete failure to respond to the treatment was unusual but did occur. It appears to be best to begin the treatment by using the solution one-half strength, increasing tentatively to full strength if the pain is not too great. Some of the chronic indolent cases did not respond until full strength was used, but the majority of the patients did well with a less concentration. If possible, the application should be tri-weekly at least; however, in clinic work this is often impossible. An elastic webbing bandage for severe varicosities was used during the day in a few instances. The authors have used this treatment for two and a half years on all varicose and traumatic ulcers, and have always had encouraging results.

The Use of Mercurochrome-220 Soluble in the Treatment of Infectious Diseases of the Skin (H. H. Young, J. H. Hill, and W. L. Deeny, *Archives of Dermatology and Syphilology*, April, 1926).—In this article the authors present the results obtained by the use of mercurochrome, intravenously, in the treatment of a large number of cases of skin infections. Twenty-four patients with erysipelas, twenty of whom were cured or greatly improved; eleven patients with furuncles and carbuncles, of which ten were cured and one greatly improved; four cases of chancroidal ulcerations, all of which healed rapidly; thirty-six patients with cellulitis and abscesses, of whom twenty-one recovered promptly with no other treatment, and nine of whom showed marked improvement and recovery after mercurochrome therapy, other treatment being also given, making a total of thirty cases, or 83·3 per cent., cured or greatly improved; two patients with gas gangrene, in both of whom the infection was eliminated; one patient with diabetic gangrene, in whom an accompanying infection was checked; three patients with pemphigus, all of whom showed marked improvement, two of them so far without relapse, one with relapse; four patients with psoriasis, two of whom are apparently cured, one markedly improved, and one improved, but with a relapse; one patient with eczema, temporarily improved; one patient with syphilis with exterior skin lesions, in whom the lesions were healed; forty-four patients with leprosy, twenty-eight of whom were improved and with remarkable disappearance of the skin ulcers. The facts given are sufficient to demonstrate that in mercurochrome, administered intravenously, a drug of great value in the treatment of infections of the skin with various streptococci, staphylococci, bacilli, and probably also *B. welchii*, is at hand. Other types of infection, the organism being unknown, may also be favourably and rapidly influenced by treatment. This series of cases is presented with the hope that it may stimulate sufficient interest among dermatologists to bring about a thorough trial of the drug in dermatology, a field which offers every prospect of splendid success.

Intestinal Intolerance for Carbohydrate Associated with Overgrowth of the Gas Bacillus (Bacillus Welchii) (A. I. Kendall, *Journal of the American Medical Association*, March 13, 1926).—The syndrome here described is one rather commonly encountered among persons of middle age. There is no outstanding qualitative symptom. The patients are, as Robert Koch once said in another connection, "enjoying a state of rude health," neither conspicuously ill nor fully well. The ætiology, which seems to be associated with intestinal intolerance for carbohydrates (especially the small intestine) is not at all clear. Gas bacilli, less commonly members of the mucosus group of bacilli of the starch fermenting type, are found in unusual numbers in a great majority of cases. It is not predicated, however, that these organisms are necessarily the primary incitants of the disorder. The hypothesis is advanced, and there seems to be some basis in fact, that one important factor in the overgrowth and probable upward extension of the gas bacillus is a decrease in the number of normal lactic acid bacteria in the small intestine. Adding preformed lactic acid to the intestinal contents by frequent administration of well-soured milk tends to correct this deficit. Whatever the cause may finally prove, a regimen containing low carbohydrate, considerable protein and some fats,

together with liberal and frequent administration of well-soured milk, has proved to be of very definite —almost specific—value in re-establishing normal intestinal conditions.

A Case of Sickle Cell Anæmia in the Sudan (R. G. Archibald, *Trans. of the Royal Society of Tropical Medicine and Hygiene*, *January* 21, 1926).—A case of anæmia associated with marked debility, pyrexia, slight jaundice, œdema of the feet, enlargement of the liver and lymphatic glands, occurring in a native of the Sudan, was observed. Blood examination showed a diminution of the red blood-cells, leucocytosis, low hæmaglobin percentage, colour index of 0·9 erythroblasts and phagocytosis of red blood-cells. The most striking feature in fresh and stained preparations of the blood was the large number of elongated and sickle-shaped erythrocytes, averaging nearly 50 per cent. Hanging drop preparations of fresh blood suitably sealed and kept at room temperature (31° C.) showed, after twenty-four hours, nearly 100 per cent. of sickle cells. The sickling is apparently due to some inherent property of the cell, independent of any substance in the serum. The blood-picture is identical with that of sickle cell anæmia, a specific entity investigated by American writers. Clinical characters of the cases corresponded to those of sickle cell anæmia, differing only in the absence of any skin lesion. The ætiology is obscure, cultural tests and animal inoculations yielding negative results.

Treatment of Hookworm Disease in Pregnant Women with Carbon Tetrachloride (J. V. Insfran, *Journal of the American Medical Association*, March 13, 1926).—Pregnancy need no longer be considered a contraindication to anthelmintic medication in areas where *Necator americanus* is the offending agent and carbon tetrachloride the anthelmintic used. The use of a mixture of oil of chenopodium and carbon tetrachloride in areas where *Ankylostoma duodenale* predominates may be possible. The pregnant woman reacts favourably almost immediately to anthelmintic medication.

Hexylresorcinol in Infection of the Urinary Tract. Results in Sixty-three Cases (D. A. Brown, *Journal of the American Medical Association*, March 6, 1926).—Since adopting this technic, no case of gastrectomy has been encountered, even though the maximum specimen has been 23·5 cm. long, in which the stump of the stomach could not be united to the stump of the duodenum by this modified Billroth I operation. If, however, this is impossible, it is believed that the Hofmeister operation, a modified form of the Billroth II, would be the operation of choice. Instead of the stump of the stomach being sutured and an independent posterior gastro-enterostomy being done as in the original Billroth II operation, the upper portion of the stump of the stomach is closed with sutures and the lower third is anastomosed to the jejunum. This is simpler than the original Billroth II, and it seems to be quite as efficacious. It must be recalled that the absence of peristalsis in the left third of the stomach does not necessitate the performance of an anastomosis in any particular axis, because here the contractions are tonic and gravity really helps, whereas in a region of the stomach with active peristaltic waves the anastomosis should be made as far as possible along the lesser curvature.

Gastric Secretion in Experimental Beriberi in the Dog (M. B. Farnum, *Archives of Internal Medicine*, February 15, 1926).— Feeding a beriberi-producing diet to a dog gradually decreases the total volume as well as the free and the total acidity of gastric secretion. The gastric secretory mechanism in beriberi is not only less responsive to the partaking of food, but it is also appreciably more refractive towards histamine hydrochloride injection. The gastric response after gastrin injection is modified only slightly, if at all. The harmful effect of alkali in the autoclaving process is not due to racemization of the proteins, but to destruction of the antineuritic vitamin. The antineuritic vitamin is not a gastric secretagogue.

Studies of Trichomonas buccalis (M. J. Hogue, *American Journal of Tropical Medicine*, January, 1926).—*Trichomonas buccalis* has been found only in the mouths of persons suffering from pyorrhœa, acute gingivitis, or abscessed teeth. It has been found in upper and lower jaws in negroes and in white persons. Four of nine cases were examined for *Trichomonas hominis* and found negative. It has been cultured for over seven months with more than 112 transfers. It grows well in acid and in alkaline media. The thermal death point is 45 degrees for five minutes. It contains neutral red granules when stained with neutral red. It has the power of reducing janus green B. to diethylsafranin. It has round and slightly oval mitochondria. Neosalvarsan is not specific for *T. buccalis*.

Blood Cholesterol Findings in Syphilis and in Other Skin Diseases. An Accurate Technic for Extracting Blood Cholesterol (I. Rosen and F. Krasnow, *Archives of Dermatology and Syphilology*, April, 1926).—The blood cholesterol was low in 100 per cent. of the patients with untreated primary syphilis, 50 per cent. of the untreated secondary cases, and in 25 per cent. of the untreated tertiary cases. After treatment all our primary cases showed a rise in the cholesterol content to normal or above normal, whereas some of the secondary and tertiary cases remained a low

value. The blood cholesterol content in two infants with active manifestations of syphilis was low. The blood cholesterol content in 82 per cent. of the treated patients who had congenital syphilis was normal. There seems to be no direct connection, at least so far as these studies are concerned, between the cholesterol content of the blood and the results of the Wassermann reaction. The cholesterol content of the blood was high in psoriasis and dermatitis venenata, and normal in acne vulgaris, dermatophytosis and dermatitis seborrhœica.

Typhoid Fever in Cochin China (P. Lalung-Bonnaire and R. Pons, *Arch. des Instituts Pasteur d'Indochine*, Oct., 1925).—Typhoid fever was identified for the first time in Cochin China in 1861 and it is still widely spread throughout the country. No race is exempt from the malady, both natives and Europeans are equally affected. The atypical form is more frequently met with in natives than in Europeans.

Notes on the Ætiology of Eczema (F. C. Combes, *Medical Journal and Record*).—It has been proved that external irritation alone is not a sufficient cause for eczema. In those cases in which external irritation is the sole apparent cause, a parasite is probably present, and it can be assumed that a non-eczematous lesion is being dealt with. The most reasonable cause of the disease lies in a lack of balance in the autonomic nervous system, associated usually with an external exciting factor. The internal treatment of the disease should be along lines to restore this balance to normal, rather than by measures directed towards the collection of the various manifestations of vagotonia and sympatheticotonia.

A Contribution to the Study of Onchocerca volvulus Leuckart, with some Observations on its Prevalence in Nigeria (N. A. Dyce-Sharp, *Trans. of Royal Society of Tropical Medicine*, January 21, 1926).—The author's investigations were carried out at Kaduna, Nigeria, where onchocerciasis is not rarely met with; it is far more common than has hitherto been described, but so far has never been observed in Europeans. Onchocerca carriers are usually healthy individuals who do not always exhibit obvious tumours or skin affections. The embryo is more often found in the skin than in definite tumours. The larvæ of *O. volvulus* occur with great frequency in hydrocele fluid in Nigeria, and while possibly innocuous, they may well stand in some causal relationship to this condition as well as to elephantiasis. *Agamofilaria streptocerca* Macfie and Corson, 1922, is not found at Kaduna among natives drawn from all over the country. This organism, moreover, is easily distinguishable from the embryos of *O. volvulus*, with which, on the Gold Coast, it is so often associated.

Reviews.

A Manual of Bacteriology, Clinical and Applied. By R. Tanner Hewlett, M.D., F.R.C.P., D.P.H., Emeritus Professor of Bacteriology in the University of London. Eighth edition. Pp. 645. With 38 plates and 63 figures in the text. London: J. & A. Churchill. 1926.

Hewlett's Bacteriology, which has so long been considered the foremost English manual on this subject, now appears in the eighth edition. Being so well and so widely known, it suffices to indicate the changes which the new edition incorporates. Partly by the use of new type, but chiefly by rigorous revision and the omission of old matter which has served its purpose, the author has actually succeeded in cutting down the size of the book by about 160 pages, and this notwithstanding the inclusion of much new work. On this feat alone Professor Hewlett is to be congratulated, and has doubtless earned the gratitude of the overburdened student. In addition to many revisions and extensions throughout the book, with the addition of new methods in many sections, the chief new work includes a chapter on the neurotropic viruses, including herpes, the Oskov technique of single cell culture, the bacteriophage, tularæmia, *Bacterium pneumosintes*, Rámon's flocculation test in the standardization of diphtheria antitoxin, the Sigma reaction, Kahn's precipitation test for syphilis, the Dick test for scarlet fever, and Gye and Barnard's recent work on malignant disease. This enumeration clearly indicates how thoroughly up to date this edition has been brought, so that it cannot fail to maintain and may even enhance the high reputation which this manual has always enjoyed. F. E. T.

Yatren 105 in the Treatment of Amœbic Dysentery. By Prof. Dr. R. Ruge. The Behring Works Publication Department, Marburg-Lagn.

This monograph contains an interesting illustrated account of amœbic dysentery in all its aspects with special reference to the use of Yatren 105, with which better results are claimed than from the use of emetin without the dangers attendant on the use of the latter. In an appendix it is also stated that in bacillary dysentery and in *Trichomonas*, *Lamblia* and *Balantidium* infections good recults are obtained by the use of this medicament. F. E. T.

The Engineer and the Prevention of Malaria. By H. Home, M.Inst.C.E. Pp. 176. Price 13s. 6d. net. London: Chapman & Hall. 1926.

This volume appeals both to the engineer and to the medical practitioner working in tropical regions. General engineering literature contains very few references to the problems of the transmission and prevention of malaria. The author has here gathered together a sufficiency of public health, entomology and parasitology to give the engineer a general view of the modern field of operations, gained from experience on the Central American coast, the

West Indies, the West Coast of Africa, Egypt and Syria. The engineer is thus placed in a position to criticize the design of engineering works from the antimalarial viewpoint and to design the necessary ancillary works required by malarial conditions. The medical officer, again, will learn many engineering details in connection with houses and quarters, drainage, oiling, mosquito netting, and so on. The book is profusely illustrated and well got up.

F. E. T.

A Text-Book of Midwifery for Medical Schools and Colleges in India. By Kedarnath Das, C.I.E., M.D., Professor of Midwifery and Gynæcology, Carmichael Medical College, Calcutta. Second edition. Pp. 495, with 281 illustrations. Calcutta and Simla: Thacker, Spink & Co. 1926.

We consider that the students in the medical schools and colleges in India should consider themselves fortunate in having this book specially written for them, and it should prove a great success. It contains a large number of illustrations, chiefly from classical sources, and all duly acknowledged, and constitutes a concise, practical, reliable and thoroughly up-to-date guide to the theory and practice of modern midwifery. F. E. T.

The House-Fly: Its Life-History, Importance as a Disease Carrier, and Practical Measures for its Suppression. By Major E. E. Austin, D.S.O., Deputy Keeper, Department of Entomology, British Museum (Natural History). Economic Series, No. 1a. Pp. 61. Price 1s. London: Printed by Order of the Trustees of the British Museum, 1926.

This is the second edition of a pamphlet published in 1920 under the slightly different title, "The House-Fly: Its Life-History and Practical Measures for its Suppression." This new edition has been thoroughly revised and expanded by the addition of new matter dealing respectively with insect enemies of the house-fly, the insect's connection with animal disease, and bionomics and control. This excellent pamphlet, with its instructive illustrations, contains all that is needful for the medical student and practitioner to know. F. E. T.

A Synopsis of the Families and Genera of Nematoda. By H. A. Bayliss, M.A., D.Sc., British Museum (Natural History), and H. Daubney, M.Sc., M.R.C.V.S., Veterinary Research Laboratory, Kabete, Kenya Colony. London: Printed by Order of the Trustees of the British Museum. Pp. 277. Price 10s. 6d. 1926.

This monograph of Dr. Bayliss and Captain Daubney is not merely a synopsis, but a comprehensive account embracing the nematoda as a whole and containing diagnoses either of genera, or of families or higher groups to which the worker can turn confidently for guidance and assistance in the determination of specimens. The authors consider that the prevailing custom of separating the nematodes into free-living and parasitic groups leads to an unnatural scheme of classification, since all degrees of parasitism, permanent and temporary, are found among them, and any such arbitrary division must be made in total disregard of obvious morphological similarities. The literature is also dealt with up to 1923, the more important sources of information only being given, and no attempt has been made to compile a complete bibliography. Workers in helminthology have long felt the need of just such a volume as the present, and they can turn to this one with the utmost confidence. F. E. T.

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Original Communications.

NOTES ON THE ANALYSIS OF SPRUE STOOLS.

By H. B. Newham, C.M.G., M.D., M.R.C.P.

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The figures quoted below are derived from a study of eleven cases of sprue which have been under treatment and observation during the past six months in the Hospital for Tropical Diseases connected with the London School of Hygiene and Tropical Medicine.

All the cases studied were typical examples of the disease with well marked symptoms and in a fairly acute stage of the disease on admission. Through the kindness of the physicians of the hospital I have been enabled to make use of their cases for the purposes of this investigation and I desire to record my grateful thanks to Drs. Low, Manson-Bahr and Sir Leonard Rogers for their courtesy and co-operation.

Fat Content.

Chemical analysis of sprue stools, more particularly with regard to the fat content, have been undertaken by various workers. Amongst these several German workers have devoted a good deal of attention to the subject, but from British scientists few definite figures are available.

Cammidge [1] has given figures in thirteen cases of the disease which he has investigated, and Mackie and Malandkar [2] working in Bombay supply details of eighteen cases investigated by them.

The results in both cases show a marked increase in the total fat of the fæces and a definite increase in the proportions of combined fatty acids (soaps) as compared with the normal.

As far as one can judge these results are based on the examination of more or less casual stools, doubtless quite typical specimens, but no mention is made as to the stage of the disease at the time of collection or whether they were twenty-four-hour specimens. With a view to ascertaining whether analyses conducted at definite intervals on typical cases of sprue would afford any evidence as to improvement or otherwise in the general condition of the patient as regards the disease I have carried out weekly analyses on a series of six cases. All of these cases were quite typical and in a fairly acute stage of the disease on admission. All improved enormously, as a result of treatment, with loss of diarrhœa, increase of weight, loss of anæmia and the passage of formed stools.

In all instances Cammidge's method of analysis was followed. Of these six cases four were submitted to weekly analyses over a period of five weeks each whilst one was analysed for seven consecutive weeks and one for eight.

A table is appended showing the average figures for the various constituents obtained in these six cases.

Table I.

Case	Times examined	Total fat per cent.	Combined fatty acid per cent.	Neutral fat per cent.	Free fatty acid per cent.
		43·7	27·3	7·45	9·0
1	8	(50·0—38·0)	(35·6—22·0)	(13·82—1·24)	(14·76— 7·15)
		56·1	35·1	12·26	8·78
2	5	(64·8—49·2)	(47·6—25 2)	(23·87—4·8)	(11·2 — 6·13)
		49 0	25·3	11·24	12·4
3	7	(57·2—38·8)	(34·0—14·8)	(25·78—1·9)	(15·33—10·22)
		47·3	20·5	16·77	10·02
4	5	(56·0—40·0)	(42·0— 8·8)	(24·8 —4·8)	(11·25— 9·2)
		56·0	29·4	14·5	12·07
5	5	(66·0—42·0)	(44·0—20·0)	(31·8 —3·4)	(17·4 — 7·2)
		56·1	32·5	9·2	14·31
6	5	(70·8—41·6)	(38·0—26·0)	(18·5 —0·70)	(18·4 —12·27)

It will be seen that generally speaking the averages for the various substances determined are much on a par with those obtained by Cammidge and Mackie and Malandkar in similar cases.

Table II.—Case 4. Weekly Examinations.

Date	Total fat per cent.	Combined fatty acid per cent.	Neutral fat per cent.	Free fatty acid per cent.
December 15, 1925	56 0	42·0	4·8	9·2
,, 23, ,,	56·0	22 0	24·8	9·2
,, 30, ,,	40·8	8·8	20·75	11·25
January 6, 1926	40·0	12·0	17·78	10·22
,, 13, ,,	44 0	18·0	15·75	10·22

As a result of these repeated analyses certain facts emerge. Firstly it would appear (as is seen in the detailed figures for Case 4 here appended) that with the progressive improvement in the patient's condition the only figures that seem to reflect this improvement are the ones for total fat. These appear to show a slow and very gradual improvement, but not to the extent one would be led to expect from the often very marked or even dramatic improvement in the patient's general condition. Moreover, it seems that a very long time must elapse in a case of sprue before the figures for total fat approximate to normal.

In one instance of the disease in which an analysis of the stool was made eight months after all signs of the disease had disappeared, when the patient was, to all intents and purposes, in excellent health and taking ordinary mixed diet, the figure obtained for total fat still showed an appreciable level well above normal, though marked

improvement is to be noticed in the figures for neutral fat and free fatty acid.

TABLE III.—CASE 7.

Date	Total fat per cent.	Combined fatty acid per cent.	Neutral fat per cent.	Free fatty acid per cent.
June 29, 1925	54·5	13·5	29·1	11·9
July 5, ,,	68·4	34·4	14·7	19·3
April 22, 1926	34·0	22·0	5 87	6·13

Secondly, it is seen that the proportions of soaps, neutral fat and fatty acid vary very largely from week to week. This is well seen in the figures given for Case 4 (Table II).

These variations in the proportions of the different fatty constituents of the stools as noted from week to week might appear to be accounted for by some slight changes and increase in the diet and it was decided to investigate a further case by daily examination of the stools.

In this case, which was one showing typical signs of sprue, but in which definite improvement had set in, daily examination of total twenty-four-hour stools over a period of six days was undertaken, the patient meanwhile having no change made in his diet.

The figures obtained in this case are herewith appended and it will be seen that very considerable variations are to be noted more especially in those for neutral fat, which range between 7·82 per cent. and 1·78 per cent.

TABLE IV.—CASE 8.

Date	Total fat per cent.	Combined fatty acid per cent.	Neutral fat per cent.	Free fatty acid per cent.
April 23, 1926...	48·0	33·2	4·58	10·22
,, 24, ,, ...	40·0	28·0	1·78	10·22
,, 25, ,, ...	44·0	28·0	7·82	8·18
,, 26, ,, ...	44·8	33·6	3·02	8·18
,, 27, ,, ...	40 0	32·0	1·87	6·13
,, 28, ,, ...	48·0	36·0	1·78	10·22

CHOLESTEROL CONTENT.

That the function of the liver is somewhat deranged in sprue is well seen from the marked change to be noted in the biliary pigments. In place of the usual urobilin (stercobilin) a predominance of the colourless urobilinogen obtains and it is to this compound that the well-known pallor of the sprue stool is largely due. Moreover, in the early and acute stages of sprue the liver is commonly much reduced in size and it is only after suitable treatment and when manifest improvement in the general condition of the patient is to be observed that the organ gradually returns to its normal size.

Seeing that the biliary function is deranged in this disease it was considered that possibly some light might be thrown on the nature of this derangement by an investigation of the cholesterol output in the fæces, inasmuch as bile contains appreciable amounts of this substance. According to Matthews [3] cholesterol introduced into the gut with the bile is excreted in the fæces in the form of a reduced cholesterol known as stercorin, and further he states that the output of this compound in a normal individual is approximately 0·9 grm. per diem. Careful estimations of the output of this substance in cases of sprue were made using Myer's extraction method with chloroform, with subsequent application of the Liebermann-Burchardt reaction.

In no case of the disease did the output of stercorin at all approach the figure given as normal by Matthews, and a study of the table appended will reveal that, although considerable variations in the quantities are to be noted at different estimations, in all cases the output was far below the normal.

TABLE V.

Case	Date	Output of stercorin in 24 hours
8	April 23, 1926	0·328 grm.
8	,, 24, ,,	0·170 ,,
8	,, 25, ,,	0·147 ,,
8	,, 26, ,,	0·164 ,,
8	,, 27, ,,	0·094 ,,
8	,, 28, ,,	0·142 ,,
9	March 22, ,,	0·115 ,,
10	,, 29, ,,	0·064 ,,
10	,, 30, ,,	0·034 ,,
11	April 7, ,,	0·226 ,,
11	,, 14, ,,	0·330 ,,

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LEPTOSPIRA: METHODS OF EXAMINATION: NEW HABITAT OF FREE-LIVING FORMS.

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THE name *Leptospira* (λεπτός, fine + σπεῖρα, coil) has been given to a new genus of spirochætes on account of their fine and minute spirals.

Noguchi [1], 1922, describes the new genus as follows: "It is a delicate filament with tapered ends, so closely and regularly coiled as to resemble a rope. It is actively motile and shows a tendency to bend one or both ends, forming a *C*, *S*, *Z*, or *J* as it rotates in a fluid medium; in penetrating a semi-solid medium its movements are serpentine, swiftly alternating forward, to the side, and backward, the body being flexible at any point and to any angle. No flagellum has been seen under the dark-field microscope, and preparations stained for flagella so far have not given satisfactory results. Preparations showing a single terminal flagellum at one or both ends appear to me unconvincing.

"In preparations stained by Miss Tilden the organisms gave the appearance of numerous peritrichal flagella of several microns in length along the entire length, and it is not improbable, in view of the

characteristic movements, that the organism is provided with some flagella. . . . The leptospira resists the action of 10 per cent. saponin. These characteristics are sufficient, I believe, to enable one to distinguish a leptospira from the multitude of minute forms of treponemata and other spirochætes."

The pathogenic varieties known up to the present time are:—

Leptospira icterohæmorrhagiæ, discovered by Inada and others, 1916, the cause of infective jaundice, or Weil's disease.

L. hebdomadis, discovered by Ido, Ito, and Waji, 1917, causing seven-day fever of Japan.

L. icteroides, Noguchi, 1917, the cause of yellow fever.

Blanchard and Lefrou, 1922, described a leptospira-like organism in the blood of a case of blackwater fever which they called *Spirochæta biliohæmoglobinuriæ*. This finding has not been confirmed by other workers.

Free-living leptospira have also been found which were regarded as harmless.

Wolbach and Binger, 1914, described such organisms, which they called *Spirochæta biflexa*, in the water of a stagnant pond near Boston, U.S.A.

Uhlenhuth and Zuelzer [11], 1922, "demonstrated in the tap water of Berlin a spirochæte morphologically indistinguishable from *Spirochæta icterogenes* (a synonym for *L. icterohæmorrhagiæ*) and gave it the name of *Spirochæta pseudo-icterogenes*, since it was not pathogenic." Hoffmann calls this organism *Leptospira aquatilis*.

Noguchi, 1922, examined samples of water from more or less stagnant ponds, swamps and ditches in the States. He states: " Dark-field examination revealed the presence, usually in small numbers, of leptospira in all of the samples, although in some instances the number was so small that repeated examinations were necessary in order to find one organism. Both fresh and salt water contained organisms indistinguishable from *Leptospira icterohæmorrhagiæ*; occasionally very short and minute (0·2 × 3 to 4 microns) and very heavy and long specimens (14 to 15 microns in length, maximum width 0·4 microns) were encountered. The spirals of the latter type were so tightly set together that the organisms appeared like a series of flat discs held in a row. These extremely small and large varieties are perhaps two different species, both differing from the *icterohæmorrhagiæ* type. In addition to these varieties, leptospira-like forms without any perceptible elementary spirals, apparently smooth-bodied organisms (?) were observed; whether or not they were motile could not be determined. The movements of all the leptospiras found in water were rather sluggish. We have obtained growth of the water leptospira in impure cultures on our regular leptospira medium, though with considerable difficulty. Inoculation of the leptospira water samples into guinea-pigs, white rats, and mice have been repeatedly made, but no infection could be induced in the animals. Injection of cultures likewise proved to be harmless.

I have been working at various species of leptospira during the last nine years, and my experience, having regard especially to the examination and detection of these illusive spirochætes, may not be without interest.

Methods of Examination.

Leptospira, in the case of infectious jaundice, are to be looked for in the blood, kidney and urine, and the free-living forms in water, &c.

The number of spirochætes in the blood is extremely small and their detection remarkably difficult, and in both Weil's disease and yellow fever it is almost impossible to find them beyond the third or fourth day of the disease. In guinea-pigs inoculated with infected material they may sometimes be found comparatively easily.

In cases of infective jaundice our only chance is by examination of the deposit obtained by centrifuging the *urine*.

Inada [2], 1917, states: " The percentage of spirochætes excreted in the urine gradually increases and reaches its maximum on the 15th or 16th up to the 23rd or 24th day of illness. By the 19th or 20th day practically all cases show spirochætes in the urine. After the 25th day the percentage decreases. Twenty-two out of twenty-four patients had ceased to excrete spirochætes after 40 days; one excreted them on the 42nd, another on the 63rd day. The duration of the most abundant excretion covers from three to six days."

In the Kidney of Rats.—I found that leptospira are detected more readily and in greater numbers towards the outer part of the kidney, a short distance under the capsule, and when making an emulsion with saline solution or simply with sterile distilled water, I avoid the tissue towards the hilus of the kidney. I was subsequently interested to see that Schüffner and Keunen [3, 4], 1923, state that leptospira are not evenly distributed in the kidney of naturally infected rats, but are localized in distinct foci. They are not situated within the tissue, as in guinea-pigs experimentally infected, but are to be found collected together in a number of nests in the convoluted tubules, where thick layers of leptospira cover the epithelium.

In water, leptospira are to be found chiefly in the slimy material lining the walls of a vessel, or by centrifuging the water.

These spirochætes may be examined either in the living condition in moist preparations, or in fixed and stained films, and the examination may be concerned mainly with detecting them, or with a view to the critical examination of their minute structure.

Dark-ground Illumination.

As the leptospira are invisible in the living condition by ordinary transmitted light, it is necessary to adopt some method of dark-ground illumination.

In making wet preparations or dry films it is absolutely essential to have the film as thin as possible. Failure in detecting these very minute spirochætes in living preparations is almost invariably due to

having too thick a layer, as the leptospira are so minute and delicate they either disappear in the depths, or are seen as minute oscillating bright spots of light, probably the ends of vertically lying spirochætes. The same remark applies also to stained films. Next to this, good and clean cover-glasses and slides are very important. It is very surprising how exceedingly few slides are free from blemishes when examined on a dark ground.

Dark-ground Illumination with a Dry Condenser and Stop.—In all cases I use the ordinary paraffin lamp with ½-inch wick as the source of illumination.

I use Watson's parachromatic condenser in conjunction with a Travis's expanding stop, and for the bull's-eye the field lens of a No. 2 or 3 ordinary ocular, and as objective a Leitz 8 mm. or ⅓ in. apochromatic of N.A. 0·65. After long trials I am convinced that this method is by far the quickest and most convenient for general use in the *search* for these organisms. There is no oil to creep on the surface of the stage when the slide is moved freely about, the field is extensive and uniform, and the thickness of the slide is of no importance so long as it does not exceed 1·6 mm. If a small arc or Nernst electric light were used the illumination would be much more brilliant and the spirochætes seen with greater ease, but I have always used the simple paraffin lamp, and find this quite sufficient provided, of course, the room is not flooded with brilliant sunlight, when it is quite or nearly impossible to see them.

Dark-ground Illumination with an Oil-immersion Condenser and Stop.—Here Watson's holoscopic condenser was used with the same expanding stop. The leptospira, when examined with this illumination, either with the 8 mm. objective and compensating ocular 18, or better, with the $\frac{1}{10}$-in. oil-immersion objective fitted with an iris or funnel stop, were remarkably brilliant, and with the latter objective the spirals most beautifully seen. Disadvantages: the area of illumination is small, and it was much more difficult to find a spirochæte when these were few.

If a bull's-eye is used the field of illumination is large, but it is not nearly as brilliant as without its use.

Dark-ground Illumination with Special Illuminator.—Leitz' dark-ground condenser was used, and with $\frac{1}{10}$-in. objective fitted with Leitz iris behind the back lens of the objective, to cut down its N.A., the results are extraordinarily brilliant, and with the lowest eye-piece there is a large field for hunting, whilst a more powerful ocular brings out the fine structure of the spirochætes exceedingly well.

The thickness of the slides must not exceed 1·1 mm.

Dark-ground illumination with either of the above methods may be used on stained films, either mounted or unmounted. In the latter case the stained film is examined without a cover-glass, a method which the writer introduced many years ago for the detection of *Treponema pallidum*, but of course in this case the tube length of the microscope must be greatly increased, but once found, it need never be altered. Full details of this and other methods are given in the author's "Critical Microscopy."

The Writer's New Method of Examining Living Spirochætes.

This is by far the quickest and easiest method of detecting living leptospira that I have tried, both on the leptospira from water and also from emulsion of the kidney of an infected rat, and by means of it I can examine the same spirochæte in the living and subsequently in the stained condition. It disposes of a cover-glass and the trouble of cleaning that, and the only real difficulty is to clean the slide so thoroughly that a drop of water can be spread over its surface. For this purpose I keep on the table a pot of paste made up of whiting (pulv. creta prep.) and water, and I rub this on the surface of the slide, and then polish with a clean cloth. If successful the water will spread over the surface in a thin and uniform layer. If, as often happens, the water runs up into tenticular globules, it is impossible to examine.

Take two or three clean slides of about the same thickness; on one make a mark with a grease pencil towards the end. Place this slide on the stage of the microscope, which may be inclined at a comfortable angle; with the 8 mm. objective and ocular No. 2 obtain a good, dark background, with, of course, the tube of the microscope pulled out to the correct extent for an uncovered object (which will be about the full length of the draw tube on the Continental-sized microscope). Having got everything in adjustment, remove the slide. On this slide, or on another clean slide, spread out a drop of the material containing leptospira in as thin a film as possible. Examine this, at once, under the dark ground obtained as above by a dry condenser with a stop and bull's-eye, and the spirochætes will appear remarkably clear and sharp, much better than when examined with a cover-glass and shorter tube. It is very interesting to follow the rapid movements of a leptospira, even with the low magnification, and to notice that as soon as the film begins to dry the thread-like, almost perfectly straight structure, not the least like a spirochæte, begins to throw itself into coarse spirals, and immediately the film dries the leptospira changes almost instantaneously in appearance from a delicate silvery-white organism to that of a coarse, thick, yellow structure quite unlike the spirochæte in the living condition. If, as soon as the film is dry, the position of the spirochæte under observation be marked by making a ring round it with a diamond marker, or its exact position logged, it is quite easy to remove the slide, fix and stain the film, and examine the same organism in the stained condition, with the oil immersion objective.

Stained Preparations.—Leptospira, like *T. pallidum* are not easily or readily stained, but probably the best method is to fix the film whilst wet over osmic vapour, or, as I prefer, over iodine,

for a few seconds, and when dry in absolute or methylic alcohol for five to ten minutes, and subsequently staining in Giemsa in the usual way, i.e., one drop of the stain to 1 c.c. of water, overnight.

Silver Staining, when successful, is by far the most distinctive, and brings out the minute spirals of leptospira excellently. After many years of failures, with occasionally a success, with silver staining, I have at last devised a method which never fails to give beautiful results with leptospira in water, and the preparations are quite clean, and, as far as I can tell, permanent. It is simply a modification of Fontana's method.

Place the air-dried or alcohol-fixed thin film in a wide-mouthed bottle containing acid tannic 5, acid carbolic 1, water 100. Allow it to remain three or four hours or more; the longer the time in this mordant the deeper will be the staining, but also the more the background will be stained.

Wash thoroughly under the tap; then rinse well with distilled water. Pour on the wet film a few drops of the following silver solution: To a solution of silver nitrate, 2½ or 5 per cent. in distilled water, add a few drops of liq. ammon. fort., till the sepia precipitate just dissolves when the solution is thoroughly shaken. Now add to this solution, very carefully, a few drops of fresh silver nitrate solution till the resulting liquid is slightly turbid. Allow the silver solution to act for three or four minutes, when the preparation will turn a faint yellowish-brown. Thoroughly wash the slide with distilled water. When examined the leptospira are clearly seen.

To make the preparation a permanent one, to remove any staining of the background, and to blacken the staining of the leptospira, I place the slide in ordinary toning solution that one uses in photography. To about one ounce of water in a developing dish add 4 drops of a 10 per cent. solution of ammonium sulphocyanide and 2 drops of a gold solution (1 gr. to 1 dr). Allow the slide to remain in this till the film is blackened, a matter of a few minutes. Wash well with water, then pour on a 5 per solution of hyposulphite of soda, allow it to act for a minute or so. Finally, well wash and dry.

This method of staining or impregnating with silver has given me most beautiful preparations of leptospira in water, in which the spirochætes can be picked out with quite low powers and which show under high powers the minute spirals very distinctly. The method is absolutely fool-proof, the solutions will all keep indefinitely, and the exact strength of the solutions, or the time of their action, seems of no importance.

I have only tried it once on a film from the kidney of an infected rat, but the result was not so good, as all the other structures stained. I think this difficulty will be overcome, probably by the previous use of Ruge's solutions (acetic acid 1, formalin 2, water 100), and then the silver method will, I think, displace all other methods for diagnostic purposes.

Relief Staining, i.e., the examination in a coloured medium, in which the organisms do not stain, but show up on a coloured background, is quite an old method of examining protozoa, &c., and was used by Certes as far back as 1888. Much more recently Burri used indian ink, Nitsche and Harrison used collargol and Benian used congo red and after-treatment with acid alcohol. I have been working on this subject for some years, and find that indian ink and collargol are too coarse; Benian's preparation does not keep. I have tried many other stains, such as congo red alone, anilin blue, acid fuchsin, cyanin or chinolin blue, opal blue and a host of others. The one which has given me the best results, and apparently permanent preparations, is a strong or saturated solution of nigrosin.

This is used precisely as in the indian ink method: One drop of the nigrosin solution and one drop of the water containing the leptospira are mixed on a slide, and then spread out in a film, allowed to dry, and examined with an oil immersion objective. The only difficulty is that these watery solutions do not spread well unless the slide is perfectly grease-free, and then probably the best parts to examine are towards the margins, where the spirochætes or other protozoa come out a beautiful pearly white on a blue-black, non-granular, background.

As a method of examining the fine structure, such as the minute spirals or flagellum, I think it has no equal, but as a method of spotting or detecting spirochætes it is the very worst method possible, as by its means we begin by diluting the material. When such a film is examined under the highest powers, I find Wratten's screens, Nos. 50 and 15 used together, very greatly improve the optical powers of the objective.

I have entered into the subject of methods of examination somewhat fully, as the leptospira are by no means easy objects, and as dark-ground illumination seems to be regarded with some awe by many microscopists.

In this country I have found the following pathogenic and free-living leptospira:—

Leptospira icterohæmorrhagiæ in the Common Rat in England.

I was the first to describe, in 1918 [5], the occurrence and minute structure of these spirochætes in the kidney of the rat in England. I examined the kidneys of 100 rats killed in this district, and found nine harboured these leptospira. Out of seventeen rats from a private estate near here six were infected, i.e., more than 35 per cent.

The number of spirochætes found in the emulsion of the kidney of the nine positive rats varied considerably. In the first and last rat they were very numerous, as many as eight spirochætes per field were found in the former, and large masses in the latter.

The length of each rat examined was noted, and I stated then that I thought the half-grown

rats of about 7 to 8 in. long were more likely to be infected than the very large or very small rats.

Schüffner and Keunen have since (1923) confirmed my statement. They say: "The low incidence among the young rats in Amsterdam is surprising, considering the high chance of infection to which they are exposed."

With further experience, I should say that 9 per cent. is a very low estimate, and I should expect to find 20 to 30 per cent. of adult rats infected.

Leptospira icterohæmorrhagiæ in Dogs.

On September 10, 1925, Lieut.-Col. H. W. Woodhall, M.F.H., wrote asking my help in trying to elucidate a disease which was causing great havoc among the young foxhounds of the South Dorset Hunt. They had apparently been troubled with the disease for some years, but he says, "during this year the whelps are dying like flies from a disease known as yellows." At my request the heart, liver, kidney and lungs of the next animal that died was sent to me on September 26.

I thought that the disease might possibly be infective jaundice, or even a tick-borne disease, as some years ago I found piroplasma in the blood of a cow in that neighbourhood which was suffering from red water fever. My examination, however, proved entirely negative. On September 30 the same organs from another dead pup were sent, and these were smaller in size and were in a fresher condition.

In fresh cover-glass preparations made from the outer part of the kidney I saw a very few spirochætes in fresh preparations, and subsequently in films stained with Giemsa I found, after a very prolonged hunt, a few definite leptospira, which on critical examination were indistinguishable from the *L. icterohæmorrhagiæ*.

I learnt a little later that Okell, Dalling and Pugh had previously, in 1925 [7], described the occurrence of spirochætes in the leptospiral jaundice of dogs.

Leptospira in Water in England.

In 1923 I found free-living leptospira in tap and other water in this area, and reported my experiences and methods somewhat fully in a popular science journal, *English Mechanics* [6].

"At first I took samples of water from various ponds and pools in the neighbourhood, and centrifuged about 30 c.c. of this at 1,540 revolutions per minute for about three minutes, or a smaller quantity, about 2 c.c., at 7,700 revolutions per minute for the same time, but in no case did I succeed in finding these minute organisms.

"Some time later I noticed by accident that a large bottle—a Winchester quart—which was filled from time to time with water from the main, and kept in the garage for filling up the radiator, had a greenish-brown colour on the sides and a brownish layer at the bottom. The bottle, which had been perfectly clean at first, was filled from time to time from the same tap. The bottle was emptied of all but about six ounces, and this water was thoroughly shaken up and the sides and bottom scraped. This water was poured into a perfectly clean bottle and allowed to stand. Specimens of this taken from about the middle were centrifuged as before, but no spirochætes were found in the deposit. Films made, however, from the sediment in the bottle showed comparatively numerous typical actively-moving leptospira.

"Having once found these organisms, I again examined some of the ponds and ditches which had proved negative previously, taking out a little of the brown and slimy part, and on making films from this I often met with a small number of leptospira. I examined the brown, slimy weed and the water, which was decidedly brackish, from a dock and found a few typical specimens. So far as my experience goes, I am inclined to think that these harmless leptospira might probably be found in almost any stagnant or slow-running water, especially if some of the green, slimy or vegetable matter is used to make films. I have found them, too, in the slimy layers of the bird bath in the garden, but in no case were they as numerous as in the bottle with the clear tap water."

Leptospira—a New Habitat.

In my search during the last two years for other free-living leptospira in nature, I came across quite a new habitat for these organisms. In my garden, which is on very deep sand and gravel and situated in one of the highest and dryest positions in the town, the gardener had dug a hole in the mould, filled it with dead leaves swept up from the garden, covered this with manure, and finally covered the whole with mould. On taking some of this manure, dead leaves and soil, and adding water, I found in the resulting infusion numerous leptospira. From which of the three elements did they come? I examined infusions made with soil, mould and worm casts from various parts of the garden, but found no spirochætes. I similarly examined various manures, both old and new, without success, but whenever I take the damp, dead, decayed leaves well away from the surface, even during the dry weather, and add tap, boiled or distilled water, very thoroughly stir up and allow a few minutes for the heavy part of the dirt to settle, I invariably find active-moving leptospira. At first they are not generally very easy to find, possibly owing to the turbidity of the water, and not a few are quite motionless, merely moving with the stream of fluid, but in twenty-four hours or thirty-six hours they have increased considerably, and are more active in their movements. They are usually associated with other small spirochætes and flagellated protozoa. If there has been rain during the day before the specimen is taken, the leptospira are probably present in their largest numbers in three or four hours after making an infusion. After the third or fourth day the leptospira diminish in number and many are dead, whilst various forms of bacterial life have greatly in-

creased, and at the end of five, six or seven days no more are to be found; evidently the leptospira have been overcome by the enormous number of bacteria.

These observations seem to point very clearly to the fact that the leptospira are present in the damp, dead, decaying leaves as such, and not in a spore or granule stage only.

The disappearance of leptospira from the infusion as soon as bacterial and other putrefactive changes occur, is quite in accordance with Noguchi's [8] experiments on the effects of polluted water, soil and fæces. He says: "The spirochæte of infectious jaundice is a very delicate organism, and is rapidly overwhelmed by most of the bacteria from intestinal contents, sewerage, or soil."

Hindle [9], 1925, on the other hand, actually recommends that "A portion of human fæces about the size of a pea is mixed in a Petri dish with about 20 c.c. of the water to be examined, and the mixture kept in the dark at a temperature of 25° to 30° C.," as a method of cultivating the water leptospira, and he further states that "the ordinary pathogenic strains of *L. icterohæmorrhagiæ* may be grown in a mixture of fæces and water."

I have tried on a few occasions to grow water leptospira on such a medium, but so far I have failed.

I find that all infusions in which leptospira were found had a neutral reaction to litmus. A free sample of the dead leaves was divided into two parts, to one of which ordinary water was added, to the other fresh normal urine of faint acidity; in the former leptospira were immediately found, and reached a maximum in twenty-four hours, in the latter case only one or two leptospira were seen and these were motionless.

I have found leptospira in infusions of dead damp leaves from other gardens near here. I may mention that I place these leaves in a clean beaker, and add water, and then very thoroughly mix, so that there is only about half an inch of water above the leaves. I find the spirochætes are more numerous in the fluid near the top. As Noguchi has pointed out, the search for the leptospira of jaundice should be made within the aerobic zone immediately below the surface of the culture medium.

Are the Leptospira of Water, &c., Harmless?

The leptospira of water are generally considered to be morphologically indistinguishable from that of jaundice. In my experience there are two different types of leptospira met with in water and in decomposing, dead, rotting leaves; the one, by far the more numerous, is slightly thicker, coarser, and the minute spirals are much more easily seen; the other is generally as long, often indeed longer, but is considerably finer, and the spirals much more delicate and not so readily seen. In the majority of cases I think I could distinguish the coarser but not the finer form from the leptospira of jaundice.

The water or free-living leptospira were generally regarded as having no pathogenic action, but Zuelzer [10 and 11], 1922, found that whilst these organisms from water did not give rise to any disease when inoculated directly into animals, one strain, after cultivation for 1¼ years in a serum medium, proved to be pathogenic to guinea-pigs.

Evidence seems to be accumulating to show that living leptospira may have a wide distribution in nature, and that under certain conditions these apparently harmless spirochætes may become pathogenic. The following facts seem very suggestive.

Several outbreaks of infectious jaundice have been recorded on the Continent as a result of bathing in polluted rivers, ponds, or bathing places. Manson-Bahr [12], 1922, describes the first of such cases in England in a man who fell into the Thames off Gravesend and some days later developed jaundice. Wenyon and Brown, after inoculating guinea-pigs, recovered the leptospira of Weil's disease.

Toyama [13], 1921, states that "The prevalence of Weil's disease is closely associated with conditions of the soil, and in Japan all infected districts are paddy fields or localities with swampy ground. It was noted that owing to the number of cases which occurred farmers became reluctant to work the fields," and "he found that in experimental rice fields the leptospira of Weil's disease will not thrive if the reaction of the water exceeds a certain degree of acidity, whereas if the reaction is alkaline or only slightly acid, as it is after use of the fertilizers commonly employed in Japan, the organism will live and remain virulent for about two months." He notes also "that high incidence of infection among human beings is not associated with a corresponding increase in incidence amongst rats."

Gulland and Buchanan [14], 1924, record an outbreak of infectious jaundice among the coal miners of East Lothian in which eighteen cases occurred.

Buchanan [15], 1925, investigated these mines and found in the greyish-brown, translucent, viscid slime on some of the roofs of the mines definite leptospira, although these were somewhat few in number. Two guinea-pigs were inoculated with 2 c.c. of this material with negative results. On a later occasion two more guinea-pigs were inoculated with double this quantity, i.e., 4 c.c. of a fresh sample of the same glutinous substance; both guinea-pigs died, one on the eleventh and the other on the thirteenth day, from definite spirochætal jaundice, and leptospira were found in all the organs. It is interesting to notice that direct inoculation without any cultivation of the slimy material brought about these results.

We may conclude from the above that free-living leptospira may have a wide distribution in the environments of man, and that under certain conditions, of which we have at present little definite knowledge, they may give rise to leptospiral jaundice in man and in some of the domestic animals.

I cannot help thinking that when these minute

spirochætes have become more generally recognized, that not a few cases of Weil's disease will be found which have been overlooked or regarded as a chill or influenza. It is especially to be remembered that even in definite outbreaks, such as occurred among our soldiers in Flanders, jaundice does not by any means always occur.

Stokes, Ryle and Tytler [16], 1917, state that "of 47 cases diagnosed as Weil's disease, clinically or by communication of the disease to animals, 74 per cent. developed jaundice and 26 per cent. have not shown any coloration."

At another place in the same article they state: "We cannot say definitely in how many cases of Weil's disease jaundice occurs as a clinical sign, but we estimate that it does not occur in more than 60 per cent. of cases in the epidemic with which we are dealing."

It is interesting to note that in one out of six dry films of blood taken from one of their cases, Corporal McG., kindly sent me by Adrian Stokes, I found two leptospira after an exhaustive (and a very exhausting) hunt extending over several days. In this case the films were taken on the second day of the illness, and no jaundice occurred at all. Leptospira were also found in guinea-pigs inoculated with blood from this case by Stokes.

Minute Structure of Leptospira.

The following observations are merely of academic interest. It has been rather a debatable point as to whether leptospira and many other spirochætes possess flagella.

I am now quite convinced that nearly all these organisms have one or more flagella, flagellum-like structures, or end organs, often of considerable length. For this work I have used chiefly films made with one of the relief stains, preferably with nigrosin, as mentioned above, but also well-fixed preparations stained with Giemsa. These were examined under critical conditions with the help of an oil immersion condenser and suitable colour screens. My results after months of work may be recorded in a few lines.

T. pallidum usually has a long, wavy, whip-like flagellum at one or both ends. This has no spirals in its course. This spirochæte further contains a number of dots, beads, or granules along its whole length, one or two of which are of larger size than the rest.

The leptospira, notably the water or free-living form, has also a similar flagellum at one or both ends, and in rare cases I think I have found two flagella at each end, after my friend, Mr. E. M. Nelson, had pointed out their occurrence.

It is very easy to see one or two largish granules in *T. pallidum*, *Spirochæta buccalis*, and also in the leptospira, but Mr. Nelson tells me that the leptospira consist of a tube containing a number of very fine granules, of which one or two of larger size are present. He says: "In your film of leptospira from water, I saw, after some hard work and eye-strain, the spirochætes contained dots. These were very minute and evasive, and the image was a difficult one. So your leptospira is similar to other spirochætes, only the granules are much smaller. I made careful measurements of some, and the dots averaged about 120,000 to an inch."

These facts seem to suggest that leptospira and spirochætes contain a number of spores or granules, and that disease is possibly spread by granules. This would explain why *T. pallidum* is often found only in such small numbers in the primary sore, and it is well known that *L. icterohæmorrhagiæ*, and especially *L. icteroides* of yellow fever, can only be found with difficulty in man and inoculated animals.

S. buccalis from mouth or teeth often also show a flagellum at one or both ends, and in a few I have found and logged specimens with two flagella at each end.

Quite recently I have very distinctly seen that many of the *S. buccalis* have not only long terminal flagella, but have also a number of short, delicate cilia-like projections along both sides, so that the whole spirochæte has somewhat the appearance of a miniature centipede. These projections are very short and do not measure more than 0·5 to 0·75 microns in length. Usually there are five or six of these on each side of the spirochæte.

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THE BILHARZIA PROBLEM IN SOUTH AFRICA.

By F. G. Cawston, M.D.Cantab.

Only twice in South Africa during the last ten years have I encountered cercariæ resembling those of schistosoma in isidora other than *Isidora africana* (" Physopsis "), even though I have collected examples from heavily infested pools and, on repeated occasions, exposed them to possible infection from miracidiæ. *I. africana* is unknown west of Port Elizabeth; though I have collected an infested example at Klerksdorp, Transvaal, from a tributary of the Vaal river. The Vaal river had been considered free from bilharzia infection, and there would appear to be a relative absence of the intermediate host from the western part of South Africa.

Isidora tropica (Krauss), whose shell is notoriously polymorphous, should never be mistaken for *I. africana* (Krauss), the columella of the latter shell being obvious to all. *I. tropica* is very heavily infested with amphistome cercariæ throughout the Union and it is a very widely distributed shell. It is probable that those shells in Australia which are known as *Bullinus* and have been shown by Dr. Burton Bradley to be cercariæ-carriers include the intermediate host of those amphistomes which are so common in Australian cattle.

Cercariæ-carriers, whose shells resemble those of *Isidora globosa* (Morelet), which I have found infested with cercariæ resembling schistosoma at Lorenço Marques, are found right across Central Africa from Portuguese East Africa to Sierra Leone.

Limnæa natalensis (Krauss) and *Limnæa truncatula* (Müller), the latter not so common as it is in England, are the common carriers of fasciola infestation in South Africa. The intermediate host in Southern Rhodesia is unknown; Professor MacKay has just incriminated *Limnæa brazieri* in New South Wales.

The mere presence of *I. africana* (Krauss) in any locality through which bilharzia carriers are constantly travelling must be regarded as a risk to infection. At as high an altitude as Mulder's Drift in the Transvaal, I examined over 900 examples of this species from a pool on a farm before I found the cercariæ. It was not possible to trace the source of infection, but was probably due to visitors from Zeerust. A reviewer in the *Medical Journal of South Africa* does not consider the mere presence of *I. africana* (Krauss) warrants special measures for its destruction. Of special interest in this connection is the discovery by me of this snail in the Hartebeest-poort Dam, where no prophylactic measures had been enforced to keep down the large number of fresh-water snails that were breeding in the shallow portions of this popular picnic-place for Pretoria and Johannesburg pleasure parties. Previous to this discovery I had myself collected the species heavily infested with schistosoma from one of the rivers that feeds the dam and had treated a boy from this neighbourhood who was heavily infested with the bilharzia parasites. The same writer (C. L. L.)

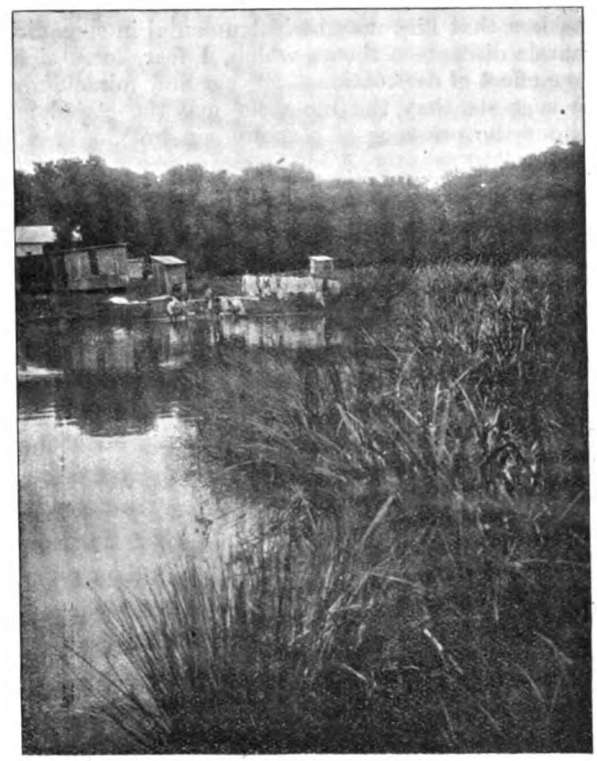


Fig. 1.—The Sydenham Pool, Durban, showing *Cyperus immensus* in profusion.



Fig. 2.—The Sydenham Pool, Durban. Favourite haunt of *Isidora africana*.

considers that flies may be instrumental in spreading bilharzia disease—a theory which, I fear, loses sight of the effect of desiccationon the egg and miracidium, and .suggests that the life-cycle may be completed without the presence of a molluscan host.

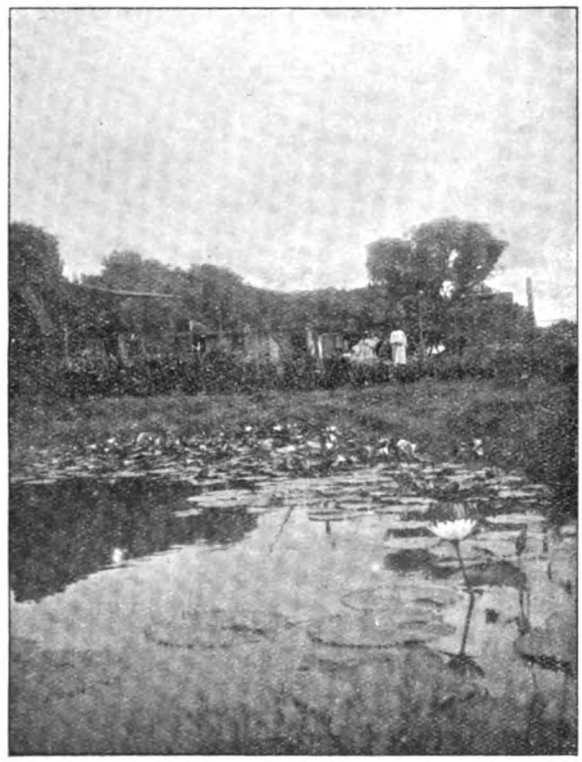


FIG. 3.—A Sydenham Pool (infested) showing blue lotus in flower.

I remember my surprise, in visiting a hospital where I had been asked to treat a typical case of bilharzia disease, to find the urine reported free from sugar, blood or albumin. On another occasion a fellow officer of the S. A. Medical Corps asked me to see a case of his of whom he had already obtained three negative reports for ova in the urine. On each occasion the failure to note the abnormality was due to the urine having been collected from a chamber—an article of furniture which medical men who appreciate the value of keeping the bed-room air sweet throughout the night should do their best to discourage. Personally I attribute little importance to a negative report except where the last ounce or so is passed direct into a separate bottle or large test-tube ready for centrifugalization. One practitioner told me he seldom if ever failed to find the eggs in a bilharzia patient, and it was his practice to persuade the natives to squeeze out the last few drops of urine. A practitioner is hardly justified in undertaking to treat a case of bilharzia unless he is able to follow the degenerative changes that are taking place in the ova passed throughout the series of injections he is giving. The number of incompletely cured cases that are being sent back to their homes is regrettable; for they tend to foster the impression that the disease cannot be cured and they are perhaps more liable to the formation of renal calculus, chronic appendicitis and exploratory operations for vague symptoms, than even the untreated case of bilharzia disease.

Dr. E. C. Faust has pointed out that the discovery of ova resembling those of *Schistosoma bovis* and *S. spindalis* in certain persons harbouring *S. hæmatobium*, or of *S. hæmatobium* and *S. mansoni*, does not necessarily mean that *S. bovis* and *S. spindalis* attack cattle and goats in South Africa, and, since the regrettable departure of Mr. R. E. Montgomery, F.R.C.V.S., from the Union, I do not think that any serious attempts have been made to determine how far schistosomiasis exists in South African mammals. In infested localities there is almost certainly a preponderance of the commoner schistosomes; but I am hoping that amongst some fifty adult worms that I obtained from cercariæ obtained from *I. africana* in a pool which contains both *S. hæmatobium* and *S. bovis*, may be examples of the rarer worm. The ova of this latter parasite would appear to be identical with those found in the urine of some children in the Belgian Congo by Dr. C. C. Chesterman.

The occasional presence of a schistosome in any host must not be regarded as sure evidence of that parasite becoming common in that host, and, although *Fasciola hepatica* does occasionally occur in Australian rabbits, the occurrence would not appear to be so common as to regard the rabbit as a constant source of fasciola infestation to sheep and oxen in that country.

A poor white at Durban, aged about 12 years, showed the ova of *S. hæmatobium*, *S. mansoni* and *S.? bovis* in his urine a year ago. Though his brother was successfully cured by intravenous tartar emetic, he is too little inconvenienced to submit to treatment himself, and three months after I first saw him, when there was much hæmaturia, the urine was almost free from blood and eggs. The problem of the eradication of the disease depends partly on education. As in Egypt, but for a very different reason, the problem is also partly a religious one. The Moslem home is usually provided with a bore hole, and there is no evidence that the disease is spread as a result of their



FIG. 4.—Shells of *Isidora africana* (Krauss).

ablutions; bilharzia disease is rare amongst Natal Moslems, who keep their children away from stagnant pools, as the orthodox Jews avoid all creeping things, including snails. Both Hindus and Christians allow their boys to paddle, fish and swim in the very pools

where the bilharzia parasites are most common, and it is a matter for regret that the Christian Church has set aside certain portions of the Jewish law which are particularly well-suited to the over-crowded life of subtropical villages, with all the inter-breeding and co-mingling of children which such a life necessarily involves. The advantages of abstinence from pork and the discouragement of a meat diet or the indiscriminate use of medicines, as practised in Moslem homes along with the universal rite of circumcision, might well be considered in the interests of those juvenile adults whose temptations are multiplied tenfold by their association with the ever-present menace of the illicit liquor traffic in Natal, and who cannot go out of their houses without passing evidences of defæcation by natives and Hindus along those undrained dongas which daily multitudes use as roads to and from the Durban market.

Ringworm of the Scalp in the Adult. Report of a Case of Kerion due to Microsporon Audouini (H. Fox, *Archives of Dermatology and Syphilology*, March, 1926).—The case described is of interest as an additional record of a rare condition, namely, ringworm of the adult scalp. The lesion, although a kerion, was caused by the *Microsporon audouini*, an organism that is not usually pyogenic. Like the three patients previously studied by the author, this one also belonged to the negro race. It may be added that the culture was made on a Stender dish instead of in the usual flask, no contamination taking place. Numerous other cultures of various species of ringworm have been made on Petri or Stender dishes, without contamination. At least sufficient time has elapsed to allow the cultures to attain full size and to be photographed.

Serological Analysis of Lepers' Sera (O. Schobl and J. Ramirez, *The Philippine Journal of Science*, March, 1926.)—Ninety-two lepers were examined serologically with the view to deciding certain doubtful points in the serology of leprosy. The question of complement and natural hæmolysin content in lepers' sera towards guinea-pig, sheep, goat and rabbit red cells was investigated. The content of hæmolytic complement and its keeping quality in the lepers' sera were studied. anti-sheep and anti-monkey immune hæmolysin having been used in these tests. Slight individual differences were found to exist in lepers' sera and in normal human sera alike as to content of natural hæmolysins and complement, but no distinct quantitative differences were found between the sera of lepers and those of normal persons. The amount of hæmolytic complement in the lepers' sera was found to be the same as that in the sera of non-lepers and is subject to individual variations. As to the keeping quality of the natural hæmolytic complement, it was found that, in proportion to the original titre, the complement decreased practically at the same rate in the sera of lepers as it did in the sera of normal individuals.

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THE RARER BRONCHOMYCOSES.

UNDER the term Bronchomycosis is included all those affections of the bronchi and lungs which are definitely associated with the presence of fungi in

the sputum. Although the monilias constitute the group of fungi which are best known and are found most frequently in this condition, it may in fact be due to quite a variety of fungi belonging to different species, genera, families and orders. No matter which of these different fungi happens to be the causal micro-organism, the symptoms and the disease so produced are somewhat similar, although the prognosis varies considerably according to the variety of the fungus encountered. The varieties of broncho-mycosis caused by fungi other than the monilias are of somewhat rare occurrence, and one of the most important of these is bronchonocardiasis, a name employed to denote all bronchial and broncho-pulmonary affections produced by fungi of the genus *Nocardia*, Toni and Trevisan, and the genus *Cohnistreptothrix*, Pinoy; the latter having perhaps been more commonly known as *Streptothrix*, *Actinomyces*, *Discomyces*, and *Oospora*. The family Nocardiaceæ has been defined as *Microsiphonales* with a mycelium, and contains two genera, namely, *Nocardia*, Toni and Trevisan, 1899, which grows anaerobically, is easy of cultivation, and produces arthrospores, and *Cohnistreptothrix*, Pinoy, 1911, which grows best anaerobically, but can grow aerobically, is difficult of cultivation, and does not produce arthrospores.

Two types of bronchonocardiasis may be differentiated, namely, *granular bronchonocardiasis*, which is often referred to as *actinomycosis bronchialis* or *pulmonalis*, and is characterized by the presence of fungal granules or sclerotia in the sputum, and *agranular bronchonocardiasis*, in which fungal granules or sclerotia are absent from the sputum, and is often referred to as *pseudo-actinomycosis bronchialis* or *pulmonalis*.

Granular bronchonocardiasis or *bronchoactinomycosis* generally runs a chronic course, though acute cases are also occasionally encountered. With regard to symptomatology there is anæmia and wasting with serotine fever. The sputum, at first mucopurulent, is later tinged with blood, and true hæmoptysis may occur. It also contains small granules composed of an enormous number of thin mycelial filaments. Potassium iodide in large doses (30 gr. thrice daily) produces a rapid improvement in this type of nocardiasis, which is much more amenable to treatment than is the agranular type. An autogenous nocardial vaccine has been employed in these cases, but does not seem to produce any definitely beneficial effect.

Agranular bronchonocardiasis, known also as *streptothricosis*, *pseudo-actinomycosis*, and *pseudo-tuberculosis*, constitutes one of the most serious of all the varieties of broncho-mycosis, generally runs a chronic course, though occasionally acute cases are seen. There is anæmia, hæmoptysis, and often serotine fever. Physical examination of the chest may reveal patches of dullness with crepitations and pleural rubbing, or may be quite negative. Microscopic and cultural examination of the sputum is of the utmost importance. Segments of thin bacillary fungi will often be found, showing true but not dichotomous branching, which are sometimes acid-fast. Both aerobic and anaerobic methods of cultivation should be employed as some nocardias (*cohnistreptothrix*) grow only anaerobically. The treatment of this variety of bronchonocardiasis is apt to be disappointing and unsatisfactory. It consists in the oral administration of potassium iodide in big doses, together with the hypodermic injection of autogenous nocardia vaccine. In spite of all treatment many cases end fatally.

Broncho-anaeromycosis is another of the rarer forms of bronchomycosis, and was investigated by Castellani, Douglas and Thompson. It is due to a branching bacillary fungus of the order Microsiphonales, which is not pathogenic to the usual laboratory animals. The fungus has been isolated from a large number of cases of bronchitis of hæmorrhagic and mucopurulent types. Cases of the hæmorrhagic type closely resemble pulmonary tuberculosis; there may be fever of an intermittent or remittent type, the patient becomes anæmic and wasted, the sputum contains blood and may present a very characteristic bright brick-red colour. The physical examination of the chest may show signs which suggest tuberculosis, such as patches of dullness and crepitations.

Broncho-oidiosis is another rare form of bronchomycosis in which the causal fungi belong to the genus *Oidium*, characterized by abundant mycelium with numerous arthrospores. In contrast to the monilias free yeast-like budding cells are absent or rare. Acid, but no gas, is produced in various sugars and other carbohydrates. The genus comprises four species, namely, *Oidium lactis*, Link, 1809, *O. rotundatum*, Castellani, 1911, *O. Asteroides*, Castellani, 1914, and *O. metalense*, Castellani, 1915. Clinically broncho-oidiosis is similar to bronchomoniliasis, and a primary and secondary form are to be distinguished.

Broncho-saccharomycetosis is due to the fungi of the genus *Saccharomyces*. These fungi are characterized by reproduction, by budding, by the absence of a mycelium, and by the presence of asci in old cultures. The symptomatology is like that of bronchomoniliasis.

Broncho-cryptococcosis, which is due to fungi belonging to the genus *Cryptococcus*, is clinically similar, occurring both in primary and secondary forms. These fungi consist of yeast-like budding cells without mycelium, and their cultures never show the presence of asci.

Broncho-endomycosis and *broncho-Williasis* are still other rare bronchomycoses, and present the same symptomatology as chronic bronchomoniliasis. Lastly, there is *Broncho-hemisporosis*, which may be caused by two species of fungus, namely, *Hemispora rugosa*, Castellani, 1910, or *H. pararugosa*, Castellani, Douglas and Thompson, 1923. Here again a mild and a severe type of the affection may be recognized. In the mild type the patient chiefly complains of cough, but the general condition remains good and there is no fever. The sputum is mucopurulent and free from blood. Physical

examination of the chest is negative, or at most reveals only a few coarse râles. The severe type closely resembles phthisis: the patient becomes emaciated, there is hectic fever, and the sputum may contain blood. Physical examination of the chest reveals patches of dullness with fine crepitations and pleural rubbing.

The sheet-anchor in the treatment of all these forms of bronchomycosis is the administration of potassium iodide in big doses, which, except in cases of agranular bronchonocardiasis, usually gives satisfactory results. This may be supplemented by the administration of balsamics, especially creosote. The use of autogenous mycotic vaccines has usually given disappointing results, and they seem to exert little or no beneficial effect on the progress of the disease. F. E. T.

Annotations.

The Nasal Passages in Lobar Pneumonia. A Clinical and Bacteriological Study (A. R. Felty and C. A. Heatley, *Journal of the American Medical Association*, April 17, 1926).—In a series of sixteen cases of lobar pneumonia, pneumococci of corresponding type to those found in the sputum were isolated from the middle fossæ of the nose in every case. The nasal passages in fifteen of the sixteen cases were examined with the nasopharyngoscope; of these, all showed hyperæmia of the mucous membranes, and six had signs of acute suppurative sinusitis. In eight cases anteroposterior roentgenograms of the sinuses were made; in seven cases clouding of one or more of the sinuses was observed. In this small series of cases acute pneumococcal sinusitis was a frequent accompaniment of lobar pneumonia.

Scarlet Fever. An Analysis (J. W. Lindsay, E. C. Rice and M. A. Selinger, *Journal of the American Medical Association*, April 17, 1926).—The intracutaneous injection of properly concentrated scarlet fever toxin, after the method of the Dicks, properly controlled by use in groups, has been found a reliable means of determining susceptibility or immunity to scarlet fever. This method is also frequently of definite assistance in diagnosis. It is possible actively to immunize susceptibles for a considerable period. Care should be used to adjust the dose of toxin for active immunization so as to avoid serious reaction in those who may have an unusually small amount of natural antitoxin, as indicated by an unusually large and intensely positive Dick reaction. There is ample evidence that the serum prepared by the method of Dochez, now available for the treatment of scarlet fever, possesses true and specific antitoxic properties in effective concentrations. The early use of sufficient amounts of antitoxin apparently reduced the incidence of complications of severe degree. A single large dose of antitoxin will probably prove more satisfactory, from every standpoint, than a small or moderate dose with the possibility of repetition. The intramuscular injection appears to be satisfactory in practically all cases, the intravenous possibly being indicated in critical conditions. The authors suggest the advisability of testing all patients for sensitiveness to serum before giving the antitoxin, even though workers are not in complete agreement as to the importance of this procedure.

Gastric and Duodenal Ulcer. Theoretical and Clinical Studies (A. Winkelstein, *Archives of Internal Medicine*, April 15, 1926).—It is seen from these studies that superficial ulcers or erosions of the stomach or duodenum occur owing to various local and general causes, but heal perfectly in most persons. In certain subjects the lesion progresses and takes on the features of chronicity. This is the characteristic of ulcer as a disease entity. The usual explanations, mostly referable to local conditions, for the failure to heal seem incomplete. It is suggested that some general condition, interfering with healing may be present. An excessive response to stimuli on the part of the nerves and tissues, locally or generally, may furnish such interference to healing. Tetany or a related condition, a disturbance of the vegetative nervous system, or a combination of both, are possible causes of the supposed general over-irritability. Patients with ulcer, with gastric neuroses, and controls were tested with various stimuli to ascertain the presence of such over-irritable states. Almost all the ulcer patients respond excessively to mechanical, electrical and pharmacologic stimulation. Patients with gastric neurosis react similarly, except to mechanical stimuli, but present a marked contrast to the ulcer group in that they display obvious stigmas of a disturbed vegetative nervous system. This distinction may prove useful clinically. The persistence of the over-irritability after a surgical cure suggests that it is a general bodily state, probably constitutional, and not merely the result of the presence of the ulcer.

Observations on the White Working Population of Tropical Queensland (R. W. Cilento, *Health*, Commonwealth of Australia, March, 1926).—In estimating the factors that affect working white people in tropical Queensland, the author arrives at conclusions which are extremely satisfactory from the standpoint of future progress, for tropical localities peopled entirely by a white population. Both sexes and all ages were examined, and the results demonstrate that there is no indication that the tropical climate affects the white man deleteriously in any respect *per se*. In making this examination the greatest care was taken to make the most of every disadvantage, and although a large portion of the homes examined were poor, where people live under the most distressing conditions, the high standard of health was still maintained.

The figures laid down demonstrate that the old canard that the white man cannot live in the tropics is definitely exploded. That the white woman cannot live and bear children there is disproved by the excellent figures shown in relation to each of the towns. That these children thrive is similarly evidenced by the statistics throughout the paper; and in their turn they multiply without any loss of fertility, mentality or physique. In fact the whole of the accusations levelled against the tropics are shown by that huge mass experiment which is called the colonization of tropical Queensland to be quite outside the question of climate itself. In the writer's opinion the evil name acquired by the tropics is due almost entirely to facts and figures which have been accepted without a due allowance being made for the tremendous importance of endemic preventable diseases, and a co-resident native population. In the Australian tropics there is neither the one nor the other, and as a consequence these lands are being steadily and progressively peopled by a healthy, working, white population.

Treatment of Neurosyphilis by Malaria. A Preliminary Report (P. O'Leary, W. H. Goeckerman, and S. Parker, *Archives of Dermatology and Syphilology*, March, 1926).—A report is made of the preliminary observations after a ten months' trial of a series of thirty-five patients with neurosyphilis who were inoculated with malaria plasmodia. As this time is too short to draw definite conclusions regarding the value of the procedure the authors have endeavoured merely to relate their experience with it. The method seems to offer more immediate effects than any form of treatment heretofore used for general paralysis. Many of the patients in this group had been treated with tryparsamide, some with benefit and others without. The inoculation of patients with *Plasmodium vivax*, who are already debilitated to some degree from their syphilis, is attended with some risk, so that it is a method for selected patients only who are under hospital care throughout the course. It is only necessary to carry out the procedure with the patient in the hospital from the time of the inoculation until three negative smears have been obtained after the quinine has been started, but measures must be taken also for the prevention of the spread of the malaria to the inhabitants of the community. The dangers of the malaria carriers must be constantly borne in mind, and all attendants must take quinine as a prophylactic during the mosquito time. Of the twenty-four patients with frank paresis, 25 per cent. showed a complete remission that allowed them to return to their former occupations within two months after the malaria was stopped, 37 per cent. were definitely improved one way or another, and two died, one as a result of the malaria and the other six months later in convulsions. Thus far in this series the "fever therapy" has had practically no effect on optic atrophy, gastric crises, persistent lightning pains with negative serologic findings, asymptomatic neurosyphilis and paresis sine paresi. The mental and physical symptoms are most favourably influenced by the treatment without change being observed in the blood or spinal fluid as yet. The use of arsphenamin, mercury or tryparsamide immediately after the malaria was attended with some definite evidence of relapse from remission. The majority of the complications noted were transient and disappeared with the cure of the malaria, although complications attributable directly to the syphilis may cause some embarrassment. Myocarditis, nephritis, marked weakness or wild delirium may demand the cessation of treatment. The results were so encouraging that the authors believe the method warrants an exhaustive trial.

Quantitative Studies of Bacterial Pollution and Natural Purification in the Ohio and the Illinois Rivers (J. K. Hoskins, *U.S. Public Health Reports*, February 19, 1926).—Quite extended observations of the pollution of Illinois and Ohio rivers have indicated that the numbers of bacteria contributed *per capita* by the sewered populations of various cities are reasonably constant; these numbers change, however, with seasonal temperature, being much greater in summer than in winter. Such bacteria tend to increase in numbers in the receiving stream for a short period and then decrease at orderly rates as the time from the point of maximum density is increased. These rates of decrease were found to be affected by water temperature and apparently by concentration, being most intensive during the warmer months and under conditions where the density of bacteria was greatest. Having established definite quantitative relationships from these observations, and assuming that they are fairly representative of stream conditions in general, a method is suggested for estimating the maximum concentration of *Bacillus coli* in streams of unknown volume of flow that may be expected to result from pollution contributed by known sewered populations. Furthermore, the concentration of such organisms remaining at any point downstream may be estimated, providing the velocity of flow is ascertained. If the observations are representative of general biological laws, they are of practical value for estimating the increasing burden placed on streams receiving the sewage of growing communities and, consequently, the added loads that water-purification plants must be prepared to handle where such polluted watercourses are used as sources of water supply.

Erythema Multiforme (E. L. McEwen, *Archives of Dermatology and Syphilology*, March, 1926).—The relationships made apparent by the author and the fact that the symptom which first caused the patient concern was a skin eruption suggest two lines of inquiry. The first is, what is the part actually taken by systemic infection

in skin diseases, particularly by the slowly progressive and initially mild types which may be grouped under the term septicæmia lenta? It is being demonstrated more and more conclusively that organisms within the body, by the products of their metabolism or disintegration, and by mechanical action are responsible directly or indirectly for numerous and varied symptom groups, many of which, though looked on as disease manifestations, are essentially protective body reactions. Conversely, more and more is the physician justified in assuming that infection, directly or indirectly, is the most probable cause of any symptom group with which he may be dealing. This statement finds confirmation in the conception and increasing acceptance of the idea of focal infection. The skin, by reason of its extent, its structure and its functions, is predestined to be the organ for the expression of a large number of manifestations which must be regarded as body reactions against harmful agencies within. Keeping in mind the fact that infection may produce primary and secondary effects, we are compelled on *a priori* grounds to regard germ action as probably constituting the major element.

A Fever Resembling a Mild Form of Typhus Fever (F. T. Wheatland, *The Medical Journal of Australia*, March 6, 1926).—A fever of about twelve or fourteen days' duration characterized by severe headache and a macular rash on the body and limbs is described. This fever resembles typhus fever, and it is probably identical with that described by Hone in Adelaide. It is not contagious, and is probably transmitted by some ectoparasite associated with the mouse. There is probably a group of diseases resembling typhus fever of which this fever is a member.

Congenital Alopecia (E. A. Oliver, and N. C. Gilbert, *Archives of Dermatology and Syphilology*, March, 1926).—In reviewing the ætiologic factors the following points present themselves. There is presumably a congenital alopecia in two brothers with no antecedent cases in the family as far as the authors can learn. There are no stigmas of atavism as noted by Hyde. One recognizes the possibility of this being secondary to some generalized cutaneous condition acquired after birth. This, however, is not believed to be the case. The first impression, that the condition was due to thyroid deficiency, would have been believed to be confirmed had thyroid medication been used without first determining the metabolic rate. Other endocrine disorders can, it is believed, be ruled out by the absence of any other factors which would be regarded as anomalies of autonomic response or control. Keratosis pilaris, as suggested by Brocq, is, the authors believe, an important factor in the production of this alopecia. The comment of the patient on his improved condition was of interest. When asked to what he attributed the improvement, he said that when he forcibly removed the papules by scrubbing his scalp vigorously, he believed he allowed the hairs to come through. With the improvement in the hair growth there was a corresponding decrease in the keratosis pilaris. As to the ætiology of the keratosis pilaris, the authors have no theory which they can substantiate, but they believe that it is due to some anomaly of intra-uterine development.

Hæmochromatosis and Chronic Poisoning With Copper (E. F. Mallory, *Archives of Internal Medicine*, March 15, 1925).—Evidence is slowly but steadily accumulating in favour of the view that chronic poisoning with copper causes the symptom complex known under the different names of hæmochromatosis, bronzed diabetes and pigment cirrhosis. Copper is an exceedingly useful and indispensable metal in many ways, but it should not be employed where it may come in contact with foods or drinks, especially if they contain acids of any sort, because it is so readily dissolved by many of them. This would exclude its use for cooking utensils of any sort, for shakers of cocktails and acid drinks, and for the worms of the condensers in stills. Its use in pipes for drinking water and for hot water heaters is probably without danger.

Current Literature.

BULLETIN DE LA SOCIÉTÉ DE PATHOLOGIE EXOTIQUE. January 13, 1926.

On the Treatment of Malaria, an Essentially Curable Disease (4th communication) (T. Seguin).—The author has been writing on this subject in the *Bulletin de la Société de Pathologie Exotique* since 1921, but little importance seems to have been given to his theory on the treatment of malaria. He is convinced that quite 100 per cent. of the cases of relapse would be avoided if the patients were treated with large doses of quinine, i.e., a dose of 50 cgm. in the evening, instead of the usual 25 cgm. which are often taken in the morning and *a fortiori* at midday. Attention is also called to the fact that large doses of quinine, instead of causing hæmoglobinuria, as suggested by some authors, has quite the opposite effect on the disease. Hæmoglobinuria occurs only in cases of malaria which have been insufficiently treated. With large doses of quinine, given at night, malaria is completely cured in a few days.

Notes on an Epidemic of Ulceromembranous and Scorbutic Stomatitis (M. Alalou).—These studies were carried out during the epidemic in the region of Mossoul from November, 1917, to April, 1918.

About 40 cases entered hospital daily, of which about twelve were cases of stomatitis. Both the ulceromembranous and scorbutic types were observed, sometimes they were mixed, and there were some cases of noma the mortality of which was about 2 per cent. Among the cases of ulceromembranous stomatitis the majority were gingival, the others were jugal, palatine, or amygdaline. Vincent's amygdalitis was of the classic type. Tincture of iodine, permanganate of potash, neosalvarsan gave unsatisfactory results. The only remedy which proved successful in all forms of the disease was chromic acid crystals.

The Anti-Piroplasmic Campaign in the Government of Petrograd in 1925. *Preliminary Note.* (W. L. Yakimoff).—In the summer of 1925 the Veterinary School of Petrograd undertook a campaign against bovine babesiasis which was prevalent in the districts of Vytegra and Volkhov. 1,040 infected animals were detected; of this number 773 were treated. The products used were ichtargan, protargol, luargol, silver salvarsan, arrhenal, and apiroplasmine. On the whole, good results were obtained showing an average mortality of only 5·9 per cent., against a mortality of 42·9 per cent. in animals not treated. Symptomatic treatment alone is not sufficient.

Apiroplasmine in the Treatment of Bovine Piroplasmosis (W. J. Yakimoff, J. G. Galouzo, W. A. Loukianoff, and M. J. Furikoff).—Apiroplasmine was first prepared by Alessandrini of Rome; it consists of cacodylate of caffeine 30 per cent., benzoinomonocarbonic acid 10 per cent., phenate of sodium 2 per cent. The instructions given with the preparation are: 20 c.c. should be given intravenously, daily, until complete cure is obtained. It was ordered by the Italian Minister of War to be used in equine piroplasmosis. During the antebabesiasis campaign in Petrograd, 1925, this product was not found to be very efficacious.

Ichtargan in the Treatment of Bovine Babesiasis in the North-West of Russia. Preliminary note. (W. L. Yakimoff).—Ichtargan is a mixture of silver and ichthyol. It has long been used in human cases of gonorrhœa and in diseases of the eye. Schmidt was the first to use it in piroplasmosis; it is largely used in Finland. Excellent results were obtained with this remedy in the treatment of babesiasis in Petrograd in 1925. The mortality was only 2·4 per cent. Hæmoglobinuria disappeared in most cases 24 hours after the intravenous injection of ichtargan, and the temperature was lowered in about the same time.

A Case of Leishmania infantum observed in Sienna, Italy. Epidemiologic Remarks. (P. Barbacci).—A fatal case of infantile Leishmaniasis in a child of four is described. It is the first case observed in the province of Sienna. It is not known how the child contracted the disease, but it is quite probable it was at Monaco, where he stayed for six weeks. Infantile Leishmaniasis occurs in nearly all places round the Mediterranean; it also exists in Indo-China and in the south of Russia.

The Action of Tryparsamide on Chronic Trypanosomiasis (F. Van den Branden).—Further investigations confirm the results already published in this Bulletin, on the action of tryparsamide "A63" in the treatment of chronic trypanosomiasis, i.e., that it is superior to any other product used in the treatment of this disease, and that failures are due to the coexistence of nervous syphilis, or to a previous arsenical treatment which has rendered the trypanosomes resistant to arsenicals.

Prescorbutic Pilous Keratosis (Said Djemil).—During the first three months of 1915 a number of soldiers from the Dardanelles entered the Couleli Hospital, Bosphorus, suffering from scurvy. Many of them presented the classical symptoms, but quite a number, when they entered the hospital, showed signs of pilous keratosis with anæmia, lassitude, and rheumatoid pains in the legs. These prescorbutic keratoid lesions are a greyish or dirty-red colour. They surround the root of the hairs on the antero-external part of the leg, they are rarely seen on the thighs, and it is exceptional to see them on the arms. They can easily be scratched off without causing exudation or bleeding. It is sufficient to observe daily the evolution of the keratose to see them take on the form of the typical follicular petechiæ of scurvy.

A Study of Trachoma in Morocco and its Treatment (E. Delanoe). — The author studied trachoma in Morocco for twelve years. The disease is widely spread, especially in the region of Mazagan, at all times of the year; it is frequently seen in adults, but the majority of cases are observed in children. There are more Arab children affected than Jewish, and this is undoubtedly due to the different schools they frequent and their different modes of living. More than half of the old and poor Jews of Mellah are affected with trachoma, and it is only their weekly visits to the hospital which keeps them alive. On the other hand, the children of these diseased people, who frequent the schools and hospital, and are kept under surveillance, are rarely affected. The infant Mussulman population, whose schools have made no hygienic progress for centuries, is heavily infested with trachoma and is a source of constant epidemics. The latent form of trachoma is the most dangerous, from the propagation point of view, as often it is of long duration without inconveniencing the patient. It is only when the seasonal conjunctivitis occurs that the trachoma is detected. A detailed description is given of the clinical symptoms. Several methods of treatment have been tried; chaulmoogra oil has given the best results.

Manifest Action of Cold in Blackwater Fever (H. Chatrieux).—Three cases are reported in which blackwater fever occurred in patients who had suddenly exposed themselves to cold. Their ages were 23, 24, and 34 years respectively. Two of them—one being a European—had never had malaria, the other had apparently had latent malaria but had not been treated.

Original Communications.

SOME ASPECTS OF MALARIA CONTROL.

By Dr. WILLIAM E. DEEKS.

General Manager, Medical Department, United Fruit Company, New York.

IN view of the present state of our knowledge, we may not hope to eradicate malaria in the near future from many localities, but reasonable control measures are possible and some of these deserve consideration.

Malaria has entirely disappeared from many localities in this country where a few years ago it was epidemic. This has been due mainly to the drainage and cultivation of the soil, and consequent destruction of many mosquito breeding places; but seasonal changes and the intelligent application of our knowledge of the transmission, prevention and cure of the disease have also been important factors. It should be emphasized that poverty and ignorance favour the spread of malaria, and that general prosperity and universal education are important influences in its control; for only when they are enlisted can suitable homes be built, sanitary measures maintained and a knowledge of how to avoid the disease acquired by the people. There is no reason, under present conditions, why an intelligent individual should acquire malaria, if he knows how to avoid contracting it, has the proper appliances available for his protection, and makes careful use of them.

Malaria is responsible for about 40 per cent. of the morbidity on the plantations of the United Fruit Company and is, therefore, the most important single factor in lowering the efficiency of labour. Effective efforts directed towards malaria control in any district presuppose a knowledge of local conditions, not only as to the breeding places of anopheles mosquitoes and a study of the most economical means of their destruction, but also regarding the identity of the vector concerned, inasmuch as there is variation of distance in the flights of the different species of anopheles that transmit malaria, and this must be taken into consideration in undertaking sanitary work.

The tropical plantations of the United Fruit Company are located, for the most part, in the coastal areas of low elevation. Rainfall and temperatures in the different plantations for the months of 1923 and 1924 are shown in the subjoined tables.

Jansco[1] states that the mosquito phase of the cycle of the tertian parasites ceases to develop normally when the temperature reaches 61° F., and if development proceeds the mosquito does not become infective. As can be noted from the tables, the temperature and the amount of rainfall on the plantations are favourable for multiplication of mosquitoes and for the exogenous development of the parasite in the mosquito the whole

[1] Jansco. "The Practice of Medicine in the Tropics," by Byam and Archibald, p. 1527, vol. ii.

METEOROLOGICAL REPORT FOR THE YEAR 1923.

AVERAGE TOTAL RAINFALL (INCHES).

Month	Banes Division	Colombia Division	Costa Rica Division	Guatemala Division	Jamaica Division	Panama Division	Preston Division	Tela Railroad	Truxillo Railroad	Average for all Divisions
January	1·97	--	9·08	14·69	4·30	7·77	2·58	6·74	8·98	—
February	0·64	—	7·80	5·05	2·40	5·45	2·74	1·76	0·88	—
March	0·98	—	7·63	2 85	1·83	5·82	0·30	0·26	1·17	—
April	1·46	0·10	5·68	4·47	2·40	3·67	1 67	0·23	0·10	—
May	2·25	4·96	11·30	2·22	8·40	4·99	3·31	1·40	2·29	—
June	1·00	1·94	18·75	8·83	2·09	14·15	3·94	4·92	5·92	—
July	1·54	0·83	15·68	11·82	2·17	14·50	3·00	4·80	6·07	—
August	1·00	1·10	19·80	9·80	3·87	16·36	1·14	4·83	4·94	—
September	4·02	2·75	10·59	6·50	2·89	9·44	4·18	5·53	5·42	—
October	13·31	8·06	9·57	4·65	11·75	3·32	8·21	8·44	6·33	—
November	9·10	1·27	22·84	6·34	7·46	16·01	3·30	8 95	5·97	—
December	1·30	0·10	25·52	6·56	3·74	20·70	1·14	4·35	5·50	—
Totals	38·57	21·11	164·24	83·78	53·30	122·18	35·51	52·21	53·57	69·38

MEAN TEMPERATURE (FAHRENHEIT).

January	78·00	85·00	77·00	74·00	77·80	77 00	80·60	75·00	79·80	—
February	75 00	81·00	76·00	78·00	76·35	77·00	79·70	75·00	79·00	—
March	75·00	82·00	80·00	78 00	77·75	77 00	83·30	79·00	79·80	—
April	78·00	84 00	80·00	80·00	77 90	78·00	80·60	84 00	80·20	—
May	78·00	82·00	84·00	82·00	84·80	82·00	86·90	82·00	82·00	—
June	83·00	84·00	87·00	75·00	82·10	81·00	84·20	81·00	83·00	—
July	89·00	91·00	75 00	80·00	83·50	78·00	84·10	83·00	82·60	—
August	89·00	81·00	89·00	79·00	84·50	78·00	86·90	81·00	81·70	—
September	82·00	83·00	88·00	79·00	83·25	80 00	94·10	81·00	87·25	—
October	80·00	84·00	79·00	78·00	—	80·00	90·50	78·00	86 25	—
November	76·00	84·00	78·00	74·00	78·80	78·00	85·10	75·00	86·25	—
December	76·00	78·00	78·00	75·00	78·40	78·00	86·90	76·00	83·60	—
Average maximum temperature	88·08	91·75	87·16	89·00	84·64	90·00	107·40	92·00	87·30	90·81
Average minimum temperature	70·33	72·17	74·25	68·00	62·89	68·00	63·00	67·00	77·58	69·25
Average mean temperature	79·99	83·25	80·70	78·00	80·47	79·00	85·20	79·00	82 62	80·91

METEOROLOGICAL REPORT FOR THE YEAR 1924.

AVERAGE TOTAL RAINFALL (INCHES).

Month	Banes Division	Colombia Division	Costa Rica Division	Guatemala Division	Jamaica Division	Panama Division	Preston Division	Tela Railroad	Truxillo Railroad	Average for all Divisions
January	3·09	—	3·49	6·25	2·27	3·30	2·54	12·45	5·33	—
February	2·78	—	8·72	15·21	2·31	4·81	2·49	16·25	12·15	—
March	0·17	1·02	5·37	0 77	1·95	3·09	0·41	2·93	1·63	—
April...	0 54	2·15	5 87	5·18	3·04	7·85	2·01	0·68	0·35	—
May	8·10	3·91	5·33	6 08	2·93	3·47	9·11	2·47	1·04	—
June	2·09	8·49	8·25	13·27	3·72	8·45	3·05	4·80	3 64	—
July	0·43	9·04	12·31	17·90	5·57	12·05	1·78	8·49	7·88	—
August	3·53	11·98	8·16	10·80	5·35	6 67	2·48	7·79	3·65	—
September	11·76	14·37	6·60	15·44	11 84	5 82	9·94	7·11	10·01	—
October	7·59	12·65	11·52	6·26	11·11	8·74	7·41	7·09	11·06	—
November	16 34	13·08	13 35	12·46	23·40	7·66	14·58	33·44	22·28	—
December	2·99	—	7·92	12·01	7·22	8·27	4·69	11·13	16·76	—
Totals	59·41	76·69	96·89	121·63	80·71	73·18	60·49	113·63	95·78	86·49

MEAN TEMPERATURE (FAHRENHEIT).

January	74·25	78·50	77·00	—	73·00	77·50	71 50	73 00	76·50	—
February	72·75	72 50	76·00	76·45	74·50	76·00	68·50	76·50	75·50	—
March	71 25	80·50	78 50	78·50	75·50	80·00	70·00	78·50	80·00	—
April	78·10	81·00	79·00	81·00	77·50	80 00	74·50	79·00	82·50	—
May	79·30	81·50	79·00	81·50	79·50	81·50	78·50	83 00	85·00	—
June	81·30	79·50	78·50	78·50	79 00	81·00	79·50	85 45	83·00	—
July	81·50	80·50	79 00	78·00	78 00	78 50	79·50	82·50	83·00	—
August	81·50	79·00	79·00	78·00	76·50	81 00	79·50	81·00	82·50	—
September	79·50	78·00	79 00	80·00	76·00	80·50	80 00	82·25	84·50	—
October	79·65	78·00	78·50	76·00	77·00	67·00	77·50	76·25	81·00	—
November	74·20	77·00	78·00	70 50	76·50	78·50	73·00	74·00	76·50	—
December	74·70	80·50	76·00	77·00	73·50	78·00	72·00	77·25	77·50	—
Average maximum temperature	91·44	93·00	90·67	—	87·16	88·50	92·83	88·59	89·83	—
Average minimum temperature	63·14	65·00	65·58	—	64·75	68·58	57·83	68·69	71·41	—
Average mean temperature	77·29	79·00	78·13	—	75·96	78·54	75·33	78·64	80 62	—

year round. The rainfall varies considerably in the different countries and from year to year, but, for the most part, is sufficient for purposes of agriculture. Irrigation is necessary only at certain seasons of the year and in some limited areas.

POPULATION.

On a plantation the labouring population consists mainly of negroes, native Indians, and mixtures of these races with European blood. Most of the illiterate people live under primitive conditions, in unscreened houses, though "bed nets" are used by a considerable proportion of the population.

The administrative personnel consists chiefly of imported whites from temperate zones. Many of these were not exposed to malaria infection before employment and, consequently, had developed no immunity to it. They live on the plantations in screened houses under good sanitary conditions.

DISEASES.

The incidence of the diseases occurring on the plantations is fully recorded in the annual reports published by the United Fruit Company. It will be noted that there is some variation in the different countries. The reasons for this probably are to be found in the differences in the physical, mental and racial characteristics of the respective populations, as well as in the local conditions of topography, character of soil, temperature and rainfall.

Thorough investigations relative to the incidence of diseases of the population in the Tela Division, Honduras, have been carried on by Dr. H. C. Clark for the past three years. In addition to this work, malaria surveys also have been made by Dr. M. A. Barber and Mr. Komp of the U.S.P.H.S. As a result of their investigations we have fairly accurate data of the incidence of this disease in this division. Conditions in the other divisions vary somewhat, but from the data obtained in the Tela Division we are able to reach conclusions and draw inferences which are also applicable, for the most part, to the other divisions.

In these surveys the method used was to take a specimen of blood from each individual and to examine it by the "thick-film" method devised by Barber. The findings do not give the actual incidence of the parasitic infection, but a minimum rate of infection only. Undoubtedly, if the blood had been taken on successive days, a greater incidence of infection would have been revealed. In this connection Dr. Clark's findings in 69 autopsies are instructive:—

INCIDENCE OF MALARIA AT AUTOPSY.

(Disregarding the disease causing the death.)

	Cases	
Parasites and pigment, present in	25	78·2 per cent positive
Pigment present in spleen and rib marrow, in	29	
Negative for pigment or parasites, in	15	... 21·7 per cent negative

SAME CASES BEFORE DEATH.

	Per cent.
Positive for malaria	39·1
Negative for malaria	52·1
Died before an examination could be made ...	8 6

These clearly show that examinations of the peripheral blood do not always give positive findings in malaria infections.

The Barber and Komp surveys were made between January 4 and February 4, 1925. During the period November, 1924, to February, 1925, inclusive, the monthly rainfalls were respectively 33·14 in., 11·13 in., 12·45 in. and 16·25 in. This represents the time when we should have our greatest percentage of malaria infection, because of relapses from chronic malaria as a result of wet and exposure, and new infections resulting from great proliferation of mosquitoes. The following table gives the summarized results of this survey:—

TABLE 11.—SUMMARY OF RESULTS IN THE TELA DIVISION.

Incidence of Crescents in Blood Specimens examined for Parasites: All sorts.

Farm	Number examined	Number positive	Per cent. positive	Number E-A	Number with crescents	Per cent. crescents
No. 7	129	59	45·7	33	12	—
No. 9	53	25	47·0	18	2	—
No. 10	81	34	41·9	27	4	—
No. 11	102	64	62·7	23	5	—
No. 12	60	29	48·3	16	5	—
No. 13	65	42	64·6	30	5	—
No. 14	84	68	80·9	51	3	—
No. 20	105	30	28·5	20	0	—
No. 25	22	6	27·2	3	0	—
No. 37	36	18	50 0	15	1	—
Lantz ...	26	15	57·5	8	0	—
Booth ...	33	31	93·9	25	4	—
Dakota	50	19	38·0	8	0	—
Hicaque	85	11	13·0	2	0	—
La Fragua	93	20	21·5	9	0	—
Total	1,024	471	46·0	288	41	14·2

Other Units.

Place	Number examined	Number positive	Per cent. positive	Number E-A	Number with crescents	Per cent. crescents
Garcia's Plant	113	28	28·3	16	5	—
San Juan ...	100	14	14·0	7	3	—
New Tela ...	193	22	11·4	16	1	—
Old Tela ...	57	11	19·3	3	1	—
Total ...	463	75	11·9	42	10	24·4
Grand total	1,487	546	36·7	330	51	15·4

	Number examined	Number positive	Per cent. positive
All farms	1,024	471	46·0
All other units	463	75	11·9

It will be noted that there is considerable variation in the percentage of infections found in the different camps and units surveyed. As explanatory of this, Dr. Barber makes a brief reference to the local conditions existing in each locality surveyed.

Farms 7 to 14 inclusive are in the Progreso District. This is a new district in the valley of the Ulua River. It contains three large lagoons —probably river-formed—streams, ponds and lesser bodies of water. Some anopheles larvæ were found in them, in rather brief surveys. Many adult anopheles, however, were discovered in the houses in the labourers' quarters located nearest these breeding places.

Farms 20, 25 and 37 are in the Guaymas District. This is also a new district, recently brought under cultivation. A search for adult anopheles throughout the camps yielded only two specimens. None was found in Camp 37. In this district there are several small streams of clear water which are stocked with fish. The rich surface loam is underlaid with a sandy soil, which facilitates rapid absorption of water following heavy rains. Consequently the mosquitoes do not breed freely in this district, but the percentage of malaria infection existing can be accounted for by the fact that these labourers were drawn from other highly-infected districts.

In both the Lantz and Booth Camps the labourers were employed in irrigation and drainage work. These men live in temporary, palm-thatched shacks without walls. In all frontier work similar conditions exist, and malaria is liable to assume epidemic proportions. This can be accounted for probably by primitive living, unusual fatigue, exposure, &c., and the opening up of virgin territory which temporarily provides new sources for mosquito breeding places.

The Dakota, Hicaque and La Fragua Camps are located in older cultivated districts where conditions are more stabilized, although in these there is a high labour turnover.

Garcia's Plant is a private plantation on the Ulua River. The house of Garcia has well-screened verandahs. An examination of the nineteen members of the household proved all to be negative. In his labouring camps, however, of 119 examined, 33 were found positive.

San Juan is a village of Caribs in a grove near the beach. There is swampy ground back of the village. The majority of the houses are palm-leaf thatched. "Bed nets" are used in many cases. As there is practically no other means of protection from mosquitoes, evidently the degree of immunity is high among the Caribs in this village.

New Tela consists of rows of houses between a swampy stream and the sea coast. The entire community is within easy flight distance of anopheles. Those houses that are near the sea are screened, and are occupied principally by a white foreign population. Back of these are rows of houses occupied by coloured people, and near the swamp rows of houses occupied by natives; all of these dwellings are unscreened. Of 48 persons examined in the American School, all were negative; of 39 examined in the coloured school, only one was positive; of 106 adult Hondurasians examined, from the rows of houses nearest the swamps, 21 were positive, and of 26 of their children examined (10 years and under), 7 were positive. The back rows of houses probably served as a mosquito barrier for those farthest from the mosquito breed-

ing grounds. Furthermore, it is probable that the Hondurasians from the mountain regions have not the degree of racial immunity possessed by the negro race.

Adjoining New Tela is Old Tela, a native town, on the sea, at the mouth of the Tela River. The people here live in unscreened houses. Anopheles breeding was found in the immediate vicinity in several places.

Dr. Clark made a resurvey of some of the camps referred to above, as well as several others during the period from May 18 to July 29, 1925. This may be considered as towards the end of the dry season, when the mosquito index is much lower than it is in the winter season. In the Progreso District 742 were examined in 14 camps and 38·2 per cent. were found positive; and in the Guaymas District, of 13 camps surveyed 19·6 per cent. were positive. In the different camps of the division, 2,742 persons were examined and 769 (28·4 per cent.) were found positive; 81 had heavy infections. Of those examined, 1,767 were men, with 26·3 per per cent. of positive findings; 611 women, with positive findings in 25·8 per cent. cases; and 364 children (10 years and under), with positive findings of 40·1 per cent.

It is also of special interest that, in Dr. Clark's surveys, of 2,607 of the native population living in unscreened quarters, 29·1 per cent. were positive; while of 135 non-immune foreigners living in screened quarters, only 6·6 per cent. were positive. Here it should be emphasized that these surveys were made on people performing their regular work—*not* bedridden.

A careful consideration of the above-named surveys enables us to draw certain conclusions.

Among the conditions that influence the incidence of malaria may be mentioned the following:—

First, rainfall. The greater the rainfall the greater are the opportunities for mosquitoes to breed, and the more anopheles mosquitoes there are the greater is the incidence of malaria.

Second, location of camps. In the camps located in good sanitary districts there is much less malaria than in those near swamps or other places where anopheles mosquitoes breed freely.

Third, screened quarters. The incidence of malaria among persons living in screened quarters is much lower than among those living in unscreened quarters.

Fourth, frontier camps. In such places, where the labourers are engaged in pioneer work, the incidence of malaria is much higher than in the older settlements.

Fifth, individual or racial immunity.

Sixth, impaired physical condition as a result of debilitating or complicating diseases.

The influence of rainfall is well exemplified in the Cuban Divisions, Banes and Preston, which are located near Nipe Bay, in the north-eastern part of Cuba. These divisions are approximately of the same size, have similar rainfalls, similar temperatures and similar classes of labour. They have entirely separate administrations. As can be noted from the temperature chart (page 185), the rainfall during 1923 in the Banes and Preston Divisions was 38·57 and 35·51 in. respectively. During that year the hospital admissions of patients with positive findings were 295 and 250 respectively, or 53 and 35 per 1,000 employees. In 1924, when the rainfall in the Banes and Preston Divisions was 59·41 and 60·49 respectively, the hospital admissions of patients with positive findings were 971 and 307 respectively, or 196 and 48 per 1,000 employees.

Clinical cases of malaria among the employees in Banes and Preston numbered 157 and 281 respectively. From this it is apparent that the additional rainfall markedly increased the number of employee hospital admissions. In the Preston Division the increase was much less marked than in the Banes Division, for the reason that in the Preston Division 15 gr. of quinine were given twice weekly to practically all the labourers, and this method was not followed in the Banes Division. The finding of a greater number of *clinical* cases in the *Preston* Division is due to the same cause; parasites are not readily discovered in the peripheral blood of those taking quinine.

The importance of other infections in lowering the resistance of the inhabitants in a malaria-infected district must be stressed. Dr. Clark, of the Tela Division, has shown that among 3,264 persons examined in 1923, the percentage of infestation by *uncinaria* was 40·1 per cent., by *Trichuris trichiura* 23·1 per cent., and by *ascaris* 19·5 per cent; and that of 3,240 examinations made in 1924, *uncinaria* infestation was found in 48·9 per cent., *Trichuris trichiura* in 28·5 per cent., and *ascaris* in 18·8 per cent. In addition to these infestations, *Oxyuris vermicularis*, *strongyloides* and *cestodes* were found in small percentages of the population of this division, and also *Balantidium coli* flagellates, and amœbiasis.

As regards amœbic infections, Dr. Clark examined the stools of only those patients suffering with some form of colitis, and the incidence of amœbiasis in the Tela Division is not properly represented by his figures. Drs. Kofoid, of California, and W. M. James, of Panama, have recently made a survey in the Colombia Division. Of 356 people examined by them, practically 50 per cent. were infected with *Amœba histolytica*. This survey was made among employees, and included persons apparently in good health, as well as some in the hospital under medical treatment for a variety of conditions. It is probable, therefore, that careful surveys of the other divisions would reveal a much larger percentage of amœbic infection than has been shown in our previous annual reports, for the reason that many obscure amœbic infections are discovered only by very careful microscopical examinations of the stools, with a view to finding this specific organism. A large number of cases with amœbic infection may not for years reveal symptoms that would lead clinicians to suspect its presence, inasmuch as many cases of amœbiasis do not suffer from dysenteric symptoms.

In addition to the infections referred to above, the Wassermann records, as shown in the following tables for 1923, 1924 and 1925, are also interesting:—

illiterate, so that it is very difficult to instruct them in sanitary matters.

Sixth, in most of the divisions the labouring population is extremely unstable; according to Dr. Clark, the turnover in the Honduras Divisions is as high as 50 per cent. per month.

WASSERMANN RECORDS, 1923.*

Race	Number tested	Positive (+ +)	Doubtful (+)	Combined percentage (probable syphilis)
Negroes and mulattoes	200	52 (26 per cent.)	18 (9 per cent.)	35
Latin-Americans	1,113	147 (13·2 per cent.)	75 (6 7 per cent.)	19·9
North Americans and Europeans	104	10 (9·6 per cent.)	13 (12·5 per cent.)	22·1
Syrians	14	2 (14·2 per cent.)	2 (14·2 per cent.)	28·4
Chinese	3	—	—	—

WASSERMANN RECORDS, 1924.*

Race	Number tested	Positive cases	Percentage positive
Central Americans	1,462	233	15·9
Negroes	117	36	30·7
Foreign Whites	121	11	9·09
Totals	1,700	280	16·4

WASSERMANN RECORDS, 1925.*

Race	Number tested	Positive cases	Percentage positive
Central Americans	1,717	254	14·7
Negroes	108	23	21·3
Foreign Whites	86	10	11·6
Chinese	2	0	0·0
Totals	1,913	287	15·0

* Based on number of individuals examined, and *not* the number of tests performed.

It will be noted in the above tables that the apparent incidence of syphilis was greater in 1923 than it was in the succeeding two years. This probably can be explained by the reason that prior to 1923 this condition was undiagnosed in many instances, as laboratory tests were not applied—and hence treatment was not instituted in all infected cases. With the aid of a laboratory diagnosis in 1923 and subsequently, it was made possible to treat *all known cases;* so that in the following two years (1924 and 1925) the percentage of positive Wassermanns may be considered as having reached a normal index in that community, which confirms also the results obtained in the Canal Zone and other large centres in this country.

Summarizing the above-mentioned conditions, we may make the following statements:—

First, judged from the standpoints of temperature and humidity, the conditions are favourable the whole year round for the multiplication of anopheles and for the sexual development of the parasite in the mosquitoes.

Second, the vast majority of the employees are labourers who live under primitive conditions, in unscreened houses. Among these persons, a large proportion of the population suffers from malaria infection. Many of them are gamete-carriers and, unprotected from the bites of mosquitoes, facilitate the spread of infection to others.

Third, many suffer from complicating infections and infestations that lower their normal resistance.

Fourth, malnutrition exists in a large proportion of these people because of insufficient or improperly-balanced diets.

Fifth, the great majority of the labourers are

Since conditions are as explained above, if any degree of malaria control is to be obtained the problems must be attacked from three angles:—

First, an attempt must be made to control the number of anopheles mosquitoes, and also to determine the species, since some of them are more important vectors than others.

Second, the malaria-carriers must be protected from anopheles contact.

Third, attempts must be made to cure the carriers.

In regard to the first of these measures, anopheles breeding places may be classified in two distinct groups. In one we have the natural breeding places, such as swampy localities, sluggish streams, ponds, seepage areas, &c. The second group consists of "man-made" breeding places—water tanks and smaller water containers of all kinds (some of which, like discarded cans and bottles, are useless and are left carelessly about); pits, ditches and similar excavations made during the process of building, road-making, and so on, and left open and neglected because some people fail to realize that these are potential breeding places for mosquitoes.

With respect to these two distinct groups of mosquito breeding places, we can expect to obtain in the first group only a very moderate control, unless unreasonable expenditures are made. Careful attention, however, should be given to the location of camp sites, in order that they may be established as far as possible from mosquito breeding places that cannot be economically controlled.

Another very important consideration is the trans-

mitting vector in any malaria district. Among the different species of anopheles that transmit malaria their powers of flight vary from one to two miles, and this fact should be taken into consideration in the selection of any camp site. All other conditions being equal, in the end it is far more economical to conduct water to a camp site or to dig wells than to locate the camp beside a body of water favourable for the breeding of mosquitoes. Of course, this is not always possible.

In any locality the sanitary measures necessary for the control of mosquitoes depend altogether upon the specific conditions. Many of these places can be controlled with reasonable expense, but many of them cannot; each must be the object of individual investigation.

As to the other group of mosquito breeding places, which we call the "*man-made variety*," there is little excuse for their existence. In many localities these are the most dangerous breeding sources because they are so often near the habitations. It is practically always possible in every community to limit the amount of anopheles breeding with only small expenditures, and thus lower the index in that locality; and the lower the index of mosquito breeding, the lower will be the malaria incidence.

Now, let us consider the second control-measure referred to; that is, the protection of malaria-carriers from anopheles contact. There is but one way to get this protection, and that is by means of effectively-screened houses. These, however, are of limited value unless the carriers remain behind the screens during the feeding hours of the mosquitoes—from sunset to sunrise. Many attempts have been made to screen the quarters of the labourers, but experience has taught us that screens cannot be maintained among the illiterate population, nor will the people seek the available protection during the time when mosquitoes are feeding. That screens are protective is amply demonstrated by Dr. Clark's recent survey in the Tela Division, where the percentage of infection among the non-immune whites living in screened quarters was only 6·6 per cent., as contrasted with the percentage of infection—29·1 per cent.—among the partially immune population living in unscreened houses. The survey of Garcia's plantation demonstrated the same thing—that effectively-screened houses are absolutely protective, but that they must be properly utilized. The right use of them necessitates a considerable amount of intelligence, education and willingness to obey sanitary regulations, and, unfortunately, these desiderata are not to be found in an illiterate population.

In regard to the third angle of approach—cure of the carriers—this is a phase of the malaria problem which has not been sufficiently stressed by malariologists. If our chronic cases could be cured or immunity could be developed, the various aspects of the malaria problem would be greatly simplified. It is patent to all experienced in the treatment of this disease that primary infections and acute exacerbations of chronic infections will yield rapidly to the administration of quinine, in the vast majority of cases; the chief difficulties consist in ridding of infection the chronic or relapsing cases. That immunity among individuals, and even races, does exist, or may be developed, partially or completely, is the belief of most malariologists. In every malaria-infected community there are some apparently immune individuals in whom malaria organisms cannot be demonstrated, and who for indefinite periods remain free from fever. Undoubtedly, in most of these instances, this immunity has been developed from attacks during childhood, though natural immunity seems to exist in a few individuals. In the surveys that have been made in Honduras, the percentage of infection is higher in children 10 years and under than in adults. This fact suggests that in children there is a low degree of immunity which probably increases as they grow older.

That immunity may become a racial development is shown by Pijper and Russell,[1] who refer to racial immunity existing among coloured races near Pretoria, South Africa. In the case of some of these people inoculation experiments completely failed to develop infection or else caused only such mild infections that cures occurred spontaneously This partial or complete immunity may explain why Pijper's and Russell's patients suffering from primary infections were so readily cured by arsenical injections. That immunity is the result of previous malarial infection, individual or racial, is a well-founded belief, and apparently demonstrates that man has defensive agents capable of being developed to protect him against the invasion of malaria parasites. The development of defensive agents is probably a function of the body cells or fluids so that these agents can function at their optimum only when the body is healthy and well-nourished.

Every experienced physician knows that a patient suffering from a disease has a better chance of recovery if there are no complicating infections or debilitating conditions. Furthermore, in every chronic condition the importance of nutrition cannot be overestimated. It is, therefore, easy to understand the difficulties experienced among our labouring population in the development of immunity, because of the numerous associated debilitating infestations and infections which exist. Our work must be directed not only toward mosquito control, but also toward the careful examination and treatment of our chronic carriers; and all associated or complicating conditions that tend to debilitate the patient must have due consideration and proper treatment. Some carriers, however, suffer from chronic, incurable, constitutional conditions or diseases that do not lend themselves to cure; hence these carriers remain a menace to the community in which they live. The only effective measure of protection for the community, therefore, lies in having the carriers live in effectively-screened houses. Continuous administration of

[1] A. Pijper, M.D., Consulting Pathologist to the Pretoria Mental Hospital, and E. D. Russell, M.R.C.S., L.R.C.P., D.P.H., Assistant Physician at the Pretoria Mental Hospital: "Observations on Inoculated Malaria." *South African Medical Record*, May 9th, 1925.

quinine will undoubtedly help to clear the trophozoites from the peripheral blood, but not always the gametes; and it is with these that we are chiefly concerned, as regards mosquito infection and the spread of malaria.

In communities where a large percentage of infection is prevalent, as determined by examination of the peripheral blood, it is astonishing to find what a small percentage of persons will be acutely ill and incapable of performing their daily duties. In the recent survey of several camps, made by Dr. Clark, of 2,742 people examined he discovered only one woman acutely ill, though 76 per cent. were positive and 81 of these had heavy infections. These patients apparently relapse or suffer acute symptoms only when they have been unduly exposed to rain or the direct rays of the sun, or when their power of resistance has been otherwise lowered temporarily, as, for example, by too much exertion. Rest in bed often is sufficient to re-establish the afebrile condition and enable the patients to continue their work. Many of the cases admitted to our hospitals are of this character. The temperature will fall after a preliminary dose of calomel, followed by Epsom salts, without even the administration of quinine, which, however, is always given routinely when malaria is suspected, whether parasites have been found or not. The administration of any sort of tonic drug to such patients would probably give similar results; we are often misled, attributing the improvement to the effect of a particular drug, when probably the same result would have been obtained even had no drug at all been given.

Patients who develop a partial immunity to malaria, and who have had an acute exacerbation readily become afebrile if their resistance is increased by any measure, no matter how simple or of what character.

In order that any satisfactory progress may be made toward ridding a community of malaria, an examination of all the inhabitants should be undertaken. The examination should not be limited to a testing of the blood for malaria infection, but should include also a thorough physical examination.

A certain percentage of the population will be found to have malaria infection and still be in apparently good physical condition; in fact, it is astonishing what a severe degree of infection may be found in certain individuals who are still able to perform their regular duties. Those in good physical condition can usually be treated at home, and administration of 10 gr. of quinine two or three times daily will rapidly clear the blood of parasites. Others, again, will be in poor physical condition. They may have light or heavy infections in the blood, associated with gametes. These are the cases which are largely responsible for the transmission of malaria and are perennial reservoirs from which mosquitoes become infected.

Thorough physical examination is necessary in order to determine the possible presence of other conditions, local or general, that lower the resistance of the patients, thus interfering with the possibility of getting rid of the malaria infection. Among the many complicating conditions may be mentioned focal infections, organic diseases, and acute or chronic infectious diseases, as well as different infestations.

According to our experience, when the patient's resistance is lowered by such conditions, it is impossible to get rid of a malaria infection by the administration of quinine only, no matter in what dosage it is given nor over what period of time. In other words, it is our belief that quinine takes care of malaria infections only when the patient is otherwise in good physical condition. Quinine does not kill parasites directly, but only in combination with some agent or agents in the body, and such an agent can act at its maximum only when the general physical condition of the patient is good.

Chronic cases, for the most part, demand care in a hospital, where thorough examinations can be undertaken and associated debilitating conditions treated, no matter what their character may be. In many cases long periods of treatment are necessary to rid the peripheral blood of gametes. Every gamete-carrier should be considered as a menace in a community, unless he lives in screened quarters, so that he is thus protected from the bites of anopheles mosquitoes.

In the treatment of acute malaria infections, whether primary or acute relapses, we have found no drug so effective as quinine or its salts in some form. But in the treatment of the chronic conditions, we have obtained much better results with a combination of drugs consisting of quinine, arsenic, iron and nux vomica. Therefore, we have devised for use on our plantations a tablet that contains quinine sulphate, 2 gr., reduced iron $\frac{3}{4}$ gr., arsenious acid $\frac{1}{50}$, and extract of nux vomica $\frac{1}{8}$. One or two tablets are given after each meal.

Because the defensive agents of the body which protect us from disease are many and elusive, probably both cellular and humoral, and because they are stimulated by many different drugs that have been usually considered as specific, it is not well to persist too long in the use of any single drug. If results are not obtained by use of one drug or one method of treatment within a satisfactory period, it is better to change to another agent. For example, we have found that in some chronic cases in which quinine, or combinations of quinine, iron and arsenic, fail to give results, iodides will effect the necessary stimulus; in other cases, alkalies; in still others, the newer arsenical preparations given intravenously, or the more recent therapeutic agents, such as stovarsol or mercurochrome. We are convinced, in other words, that proper treatment of a chronic malaria case, in order to bring about convalescence, not only taxes the diagnostic ability of the clinician, but also demands an extensive knowledge of the therapeutic action of drugs. In fact, in some cases it is necessary to resort to change of climate in order to give to the defensive agents of the body the stimulus necessary for them to throw off disease.

From time to time we hear of the apparently

specific action of a new drug in the treatment of malaria. It is quite possible that certain cases would yield to the effect of some new preparation, or some old preparation, if we were only able to determine and select the proper agent to use. We are under the impression that in many of these chronic cases large doses of quinine should not be continued for more than ten days, or fourteen days at most; that they then lose their specific usefulness and probably depress the patient. After this period, better results are obtained from the tonic doses of quinine in combination with other drugs.

The remarks made above can probably be best illustrated by means of the following case reports:—

Case I.—This was a case of persistent tertian malaria in an educated white man who has lived in the coast climate of Guatemala for eighteen years.

He had suffered a great deal from malaria, and at intervals had taken large amounts of quinine and arsenic. His recent history is as follows:—

In July, 1923, he became quite ill with malaria —mixed infection—and was given a course of quinine. He took 45 gr. daily for ten days, and 30 gr. daily for six weeks subsequently. During the latter part of this period he was in Europe. While there he stopped taking quinine for about a month and then had another malaria attack, with two definite chills on alternating days, after which he resumed his quinine. He continued to take 30 gr. daily until about the middle of January, 1924. Meanwhile, in November, he had returned to the tropics, where he lives under excellent sanitary conditions and is very little exposed to re-infection, as he lives in a screened house.

During the early part of March, his tertian malaria symptoms returned. For two weeks he took 45 gr. daily, then 30 gr. daily for eight subsequent weeks, and 10 gr. daily for several weeks after that. While still taking 10 gr. daily, he fell ill with malaria about July 12, 1924, and went back to 45 gr. a day for three weeks, subsequently continuing to take 30 gr. of quinine daily. This treatment he kept up for three months, when he reduced the dosage to 20 gr. daily, which he continued until February 1, 1925.

About this time he felt very achey in the limbs, and suffered from lassitude and other "malaria-like" symptoms. A thick-film smear showed pigment and one tertian gamete. After a consultation with several physicians, he was advised to take 30 gr. of quinine daily, 5 min. of Fowler's solution three times daily, and ½ oz. of Warburg's tincture with aloes three times daily. He adopted this treatment, and kept it up for fully five weeks; then he discontinued the Fowler's solution and took a weekly injection of salvarsan instead. In addition to this, twice a week he took intramuscular injections of 15 gr. of quinine, replacing the former evening doses by mouth.

On Monday, April 13, he was playing golf in the sun when he had a moderate chill, and went to bed with a temperature of 103° F. He complained of pain in the spleen, which, on examination, was found to be slightly enlarged. His trouble proved to be a typical tertian paroxysm. The next afternoon his temperature rose to 100·5° F., then dropped and the following day rose to 100° F. With this recurrence on Monday, April 13, all previous treatment was discontinued. A purge was given and he began the use of stovarsol, taking four tablets during the first twenty-four hours, and three daily thereafter until twenty-five had been taken.

Two weeks later the patient reported that he felt better than he had "in many moons." His tongue, which had been filthy for over a year, was almost clean, his appetite was better than it had been for months, and the tired feeling in his legs and shoulders had practically disappeared.

On October 9, 1925, the patient reported at my office, after a prolonged vacation in Europe, and stated that he was now feeling better than he had felt in a great many years.

The brilliant results obtained in this case from the use of stovarsol determined us to give it a trial in some acute cases. In this connection, two brief case reports on young men, 18 years of age, may prove of interest.

They were admitted to the Tela Hospital in Honduras on May 4, 1925, and were discharged at their own request on May 25. On admission, the one had a massive infection of E.A. malaria, and the other a massive infection of tertian malaria. In the latter case, E.A. parasites were also discovered in his peripheral blood a few days after admission. Both of these men had infections, too, of *Amœba histolytica*, accompanied by dysentery. Apart from the usual clinical manifestations of malaria, there were no other physical positive findings. The Wassermann reactions in both cases were negative.

Both of these patients were given a course of emetine, and each received a tablet of stovarsol three times daily. From the date of their admission until the date of their discharge, their bloods were examined daily by Dr. H. C. Clark, using the "thick-film" method recommended by Barber. After three days' treatment, the parasites in the peripheral blood were found to be increasing in numbers, with a corresponding increase in the gravity of the symptoms. The administration of quinine was immediately resorted to, and in one case hypodermic injections were found necessary in order to save life. Each patient received 40 gr. of quinine daily, by mouth, during the subsequent hospital period, the one taking 680 gr. in all by mouth, and the other 640 gr. plus 45 gr. by hypodermic. The daily examinations of the peripheral blood by Dr. Clark revealed crescents in the majority of the fields examined during the entire hospital period. For the last few days of their stay in the hospital, notwithstanding the presence of crescents in the peripheral blood, they had been up and about, feeling perfectly well. They themselves requested their discharge from the hospital.

It will be noted that stovarsol was of no value,

apparently, in controlling the development of malaria parasites. It was necessary to resort to quinine in order to save the lives of the patients; and notwithstanding the large amount of quinine taken by these patients, crescents were still present in their blood when they were discharged. Since these cases were reported, similar results have been obtained in a great many other instances. As demonstrated in the first case reported, however, stovarsol in some chronic cases will prove of undoubted value.

In reviewing the conditions with which we have to contend on our plantations, if we are effectively to control malaria, we would submit the following recommendations:—

First. There should be reasonable mosquito control for a radius of from one to two miles from the settlements. This, of course, necessitates use of sanitary measures in the immediate vicinity of the dwellings, as well as control of anopheles breeding in all water containers and ponds throughout this area. Such control can be economically accomplished by means of drainage, filling, fish-stocking, or else by larvaciding with Paris green or petroleum products.

Second. In new plantation work, where the conditions can be anticipated, careful selection of camp sites is always of great importance. Too often these locations are selected because of proximity to supplies of water, where mosquito breeding is perennial. If a camp site can be established one or two miles from a mosquito breeding source, it is much more economical in the long run to convey water there or dig wells, than it is to endeavour to protect the population from mosquitoes.

Third. An endeavour should be made to stabilize the population. A stable population can be gradually educated in the simpler methods of sanitation and, eventually, real co-operation can be obtained. Where there is a labour turnover of 25 per cent. every three or four weeks, the difficulties of maintaining sanitation are much greater. In order to stabilize the labouring population, we must not only build and maintain attractive and comfortable camps, but we must also provide measures for taking care of the families of married men, by furnishing them with garden facilities, schools and some forms of entertainment. In other words, we must take an interest in our people if we may hope to retain their services indefinitely. In the schools the principles of sanitation should be taught, the children should know how malaria, hookworm and other infections are contracted, and how they can be avoided. Thus, in the course of a few years, all inhabitants of the region would have a certain amount of knowledge of what measures are necessary if they are to protect themselves.

Fourth. Now the next important step can be taken—namely the screening of houses. With an ignorant population, it has been demonstrated time and again that the screens generally cannot be maintained, and even if they can be, they are of very little use to the people unless the latter are educated to appreciate the value of screens, and to realize that everyone must use the protection afforded, during the hours when anopheles are seeking warm blood. On the plantations, no public gatherings in the open at night should be permitted, but a screened meeting-house should be used. It could serve as a school in the day time, and at night for entertainment. All offices where work is necessary after sundown should be screened. In those few instances in which men are compelled to work in the open at night, prophylactic quinine should be given as a preventive. Probably fifteen grains of this twice a week will keep the peripheral blood sufficiently free from parasites to prevent mosquito infection.

General adoption of these measures not only would control multiplication of mosquitoes, and thus lower the index, but at the same time would protect the inhabitants who are already infected, and thus prevent spread of the disease.

Another measure to be aimed at is to attempt to *cure the carriers.* Careful physical examinations must be made, in order to discover complicating conditions that lower the resistance of the patient and prevent the natural defensive agents of the body from throwing off the malarial infection. All complicating conditions must be treated as well as the malarial infection—a requirement which will try the diagnostic ability and therapeutic resourcefulness of the physician.

There is no agent which, in primary infections or acute relapses, will give the same results as salts of quinine; but after the acute symptoms subside, then we must try to build up the system by all the means at our disposal, and in some instances we must resort to a change of climate in order to accomplish our purpose.

The chief difficulties in curing malaria cases are connected not with the acute forms of the disease, but with the chronic relapsing cases which carry gametes in the peripheral blood, and through which the disease spreads and is perpetrated.

Since writing the above, my attention has been directed to a report by Dr. Nocht on the work of the malaria commission of the League of Nations in the fight against malaria. The review of this publication in the *Journal of the American Medical Association* dated January 23, states as follows:—

"The only European region that has actually been freed of malaria is a certain part of Dalmatia. Water is scarce and is collected in deep, protected cisterns. The scanty shallow pools were sprayed with oil. The entire region has thus been freed of mosquitoes and malaria. Conditions have also been favourable for extermination of malaria in Palestine, he adds. There is no rainfall during the malaria season, and extensive regions have been cleared of mosquitoes. The malaria commission concluded its work by advising to limit the campaign against mosquitoes to certain regions where conditions favour it. Planless spraying with oil, draining, breeding of fishes, are only throwing money away. A single overlooked breeding-place may infect a whole village. The main reliance

must be on thorough treatment and after-treatment of every case of malaria, and discovery and treatment of every one infected with malaria (house-to-house visitation, examination of school children, &c.) and education of the public to seek out and destroy the mosquitoes that lurk in the bedrooms and living rooms, and to protect against mosquitoes by nets and screens and white walls. Quinine as a prophylactic is advised only in exceptional cases and with the strictest surveillance."

It is interesting to note that the conclusions of the malaria commission of the League of Nations are substantially the same as those expressed in this article.

FURTHER EXPERIMENTS WITH THE *GONGYLONEMA* OF CATTLE.

By H. A. Baylis, M.A., D.Sc., A. Leslie Sheather, D.Sc., M.R.C.V.S., and W. H. Andrews, D.Sc., M.R.C.V.S.

The question of the distinctness of certain forms of *Gongylonema* in domestic animals is a difficult one. Morphological studies have led one of us (Baylis, 1925, *a*, *b*, *c*), to maintain the view that it is impossible to recognize specific differences between *Gongylonema pulchrum* Molin from the pig and wild boar, *G. scutatum* (Müller) from ruminants, *G. ransomi* Chapin from the pig in America, and *G. subtile* Alessandrini from man. All these, and several other imperfectly-known forms, have been regarded as a single morphologically variable species, for which the name *G. pulchrum* Molin, 1857, has been used.

Experimental evidence appeared to be necessary if any further light were to be thrown upon the question. If it could be clearly shown that a form of *Gongylonema* parasitic in one host could be experimentally transmitted to another host, there might then, it was thought, be reasonable ground for concluding that the morphologically similar forms naturally occurring in these two hosts were identical. It should be borne in mind, however, that a negative result obtained by this method cannot, of itself, definitely decide the question of species. At the most it can only provide information which suggests that some physiological difference exists between one set of individual parasites and another. Whether that physiological difference is the expression of a specific, varietal or racial distinction of some kind, and if so of what kind, will still remain a matter of opinion.

The experiments recorded in this paper were undertaken with a view to determining, if possible, the extent to which the *Gongylonema "scutatum"* of cattle can be transmitted to other hosts. The infective material used consisted of (*a*) specimens of the small cockroach, *Blattella germanica*, which had been experimentally infected with the larvæ of the bovine *Gongylonema* in Italy (see Baylis, Pan and Sambon, 1925), and (*b*) specimens of various dung-beetles obtained from cow-dung at the village of Villa Lagarina, in the Trentino, Northern Italy. A certain percentage of these beetles was known to be fairly regularly infected with the larvæ of *Gongylonema* (see the paper referred to).

For the purposes of the experiments healthy young English animals were used, which were extremely unlikely to have come in contact with *Gongylonema*. *G. "scutatum,"* in fact, appears to be extremely rare or possibly absent altogether in this country. A calf about six months old, three two-year-old sheep and three pigs about three months old were obtained, and throughout the experiments were kept confined in stables at the Research Institute of the Royal Veterinary College. The experiments were carried out in continuation of investigations begun in Italy with the aid of a grant from the British Empire Cancer Campaign.

Calf.—On October 5, 1925, the calf received four specimens of *Blattella* from a batch experimentally infected with *Gongylonema* larvæ. The insects were broken up and placed in water, which was then administered to the animal as a drench. When killed on February 25, 1926 (*i.e.*, about twenty weeks from the date of the infective feeding), the animal was found to be heavily infected with adult *Gongylonema*, the lining of its œsophagus containing not less than eighty of the worms.

Sheep No. 1.—On October 5 this sheep received, like the calf, four of the infected *Blattella*, administered in the same way. When killed on February 25, it was found to be somewhat heavily infected with adult *Gongylonema*, at least forty-six individuals being present in the œsophagus.

Sheep No. 2.—This animal received on October 5 about twenty dung-beetles, broken up and given as a drench with water. At least three species of beetles were included in the dose (*Onthophagus taurus*, *Caccobius schreberi*, *Sphæridium* sp.). On November 11 a larger dose of beetles was given (about seventy), of which, this time,[1] about thirty were *Aphodius fimetarius*, the remainder various other species of *Aphodius* (not definitely known to act as hosts of *Gongylonema*), and a few *Sphæridium*. On November 14 another dose of about ninety-five beetles was given, of the same kinds as on the previous occasion. When killed (on the same date as the preceding animals, February 25), this sheep was found to have fifteen adult *Gongylonema* in its œsophagus.

Sheep No. 3 was kept as a control, and lived in the same stable and under the same conditions as the other two sheep, except that it was not fed with cockroaches or beetles. It was killed on March 5, and showed no infection with *Gongylonema*.

Pig No. 1 was treated similarly to the calf and sheep No. 1, i.e., on October 5 it had five *Blattella* administered to it in water as a drench. When killed on February 25 it was found to be entirely free from *Gongylonema*.

Pig No. 2 received exactly the same treatment as sheep No. 2, being fed on October 5, November 11

[1] The beetles used for the first dose were the survivors of a stock brought to England early in September, and the species represented were those most abundant during the summer months. The beetles used for the subsequent doses were received later from Villa Lagarina, and consisted of autumnal species.

and November 14 with dung-beetles. On the first occasion it received about twenty beetles, on the second about seventy, and on the third about ninety-five. The beetles were of the same kinds, in about the same proportions, as those received on the several dates by the sheep. The first dose was administered in water, but on the other two occasions the living beetles were mixed with the animal's food (mash), and were readily devoured. The pig was killed on February 25, and was entirely negative for *Gongylonema*.

The third pig was kept as a control, but as the two that had been experimentally fed were negative it was not thought necessary to destroy it.

During the period of twenty weeks occupied by the experiments the fæces of some of the animals were examined at intervals by the sugar flotation method[1] with a view to ascertaining, if possible, whether infection had taken place. In the cases of the calf and sheep it was a simple matter to obtain a small sample of fæces direct from the rectum, but this was not readily done in the case of the pigs. After the first few days, therefore, the pigs were penned separately and the fæces for examination were collected from the floor. In all cases the amount of fæcal matter taken was approximately the same and was about equivalent in volume to a hen's egg.

The fæces of the calf, sheep No. 1 and pig No. 1 were examined more frequently than those of the other animals because it was known that the cockroaches with which they were fed had been infected experimentally with *Gongylonema* larvæ, whereas it was not known whether the individual dung-beetles used were infected or not. The fæces of the calf and sheep No. 1 were examined on twenty-six occasions, and those of pig No. 1 on sixteen. Thirteen examinations were made of the fæces of sheep No. 2 and eight of those of pig No. 2. On some occasions special attempts were made to concentrate any eggs that might be present, by repeatedly adding fresh material to the same fluid and centrifuging again. In no instance were the eggs of *Gongylonema* detected.

It was thought possible that the eggs of this parasite might sink in the sugar solution used instead of rising, and to test this possibility the sediment obtained in the tubes was subjected to scrutiny on some half dozen occasions, but in all cases the result was negative. It is perhaps worthy of mention in this connection that although the fæces of the sheep constantly contained eggs of nematodes other than *Gongylonema*, yet, after flotation, none were found in the sediment when this was examined.

It has to be admitted that, in view of the facts recorded, examination of the fæces by the method employed is not a suitable means of detecting *Gongylonema* infections during life, but when it is considered how small was the sample examined, compared with the amount of fæcal matter passed each day, it is perhaps not surprising that the eggs, if they are swallowed and passed out with the fæces, escaped detection.

[1] Sheather, *Journ. Comp. Path. & Therap.*, 1923, June, vol. 36, No. 2, pp. 71-90.

The possibility that eggs might tend to pass up the œsophagus, and escape by the mouth, was also considered. On two occasions direct examination was made of the material (chiefly saliva) obtained from the calf and sheep by gently scraping the tongue and the mucous membrane of the cheeks. The second examination was made on the day preceding the slaughter of the animals, but in no case were eggs detected.

Discussion of Results.

These experiments appear to indicate that :—

(1) There is no difficulty in transmitting the *Gongylonema "scutatum"* of cattle to sheep.

(2) It is difficult or impossible to transmit the *Gongylonema "scutatum"* of cattle to pigs.

With regard to the first of these conclusions it may be noted that the question of a specific distinction between the *Gongylonema* of cattle and those naturally occurring in sheep and other ruminants seems never to have been raised. It has always been tacitly assumed that "*G. scutatum*" is the same species, whether it occurs in cattle, buffalo, sheep, goat or any other ruminant. The bovine form of *Gongylonema* has already been successfully transmitted to a sheep by Ransom and Hall (1915) by feeding the animal with experimentally-infected *Blattella*. The positive results of this and our own similar experiments are in accordance with the belief that a single species is involved.

With regard to the second conclusion, an experiment is recorded by Ransom and Hall (1915) in which a pig, fed on *Blattella* experimentally infected with the cattle *Gongylonema*, gave a negative result. The pig was killed two months after the first of two experimental feedings. It is doubtful whether this is a long enough period for the development of the worms to maturity, but had any worms been present they would probably have been sufficiently well grown to be easily detected. Our own two pigs were given a considerably longer time, and had, presumably, as good a chance of infection as the other animals fed on the same material. Ransom and Hall state that the negative result of their experiment with the pig is "suggestive of a specific infectivity and strengthens the idea that the hog nematode is a distinct species." Our own results were similar, but we cannot agree, as has been pointed out above, that this necessarily gives any ground for regarding the parasites as *specifically* distinct. It is quite possible that after a number of generations certain strains of the same species may become peculiarly adapted to certain particular host-species, and may lose to a greater or lesser degree their power of adapting themselves to another host. These strains may be on the way to the formation of distinct species, and may be regarded as "incipient" species, but in the absence of recognizable morphological differences this cannot be laid down as an established fact.

In connection with the result of the experiments on pigs, it is of interest to recall the result of an earlier experiment on rats, which has already been placed on record (Baylis, Pan and Sambon, 1925).

In this experiment two rats were successfully, though slightly, infected with the *Gongylonema* of cattle. It is somewhat surprising, in view of this, that the pigs remained negative, for it might have been expected that the conditions afforded by the pig would be more suitable for a parasite of other ungulates than those afforded by a rodent.

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AN EPIDEMIC OF CHOLERA AMONGST BALLAST TRAIN COOLIES IN BENGAL.

By E. N. D. REPPER, M.B., Ch.B.

THE successful treatment of cholera in its epidemic form is never an easy matter, but when the outbreak occurs among coolies on a ballast train the difficulties are greatly enhanced, due to the conditions under which these people live.

To those not conversant with railway workings I will give a short account of the type of ballast train in use on the Indian railways.

The train consists of about 35 to 40 open trucks, such as are used for carrying coal, &c., and is under the charge of a European or Anglo-Indian guard. These trains move from point to point on the line carrying ballast, bricks, sleepers, &c., and are loaded and unloaded by the coolies. Each train carries 160 to 180 male and female coolies besides children, of whom there are usually many. These coolies are mostly Sonthals, one of the primitive tribes, a very suspicious and illiterate people, who at times are very difficult to manage. They make their home on the train by covering one-half of their wagon with a tarpaulin. Here they live with their wives and families. Many of them are born on the train and live there all their lives.

In March this year, three trains working on my section, carrying over 500 coolies, were practically simultaneously attacked with cholera, so it was decided that the only way to deal with this outbreak successfully was to find a suitable place for a cholera camp, have the trains brought there, segregate the whole of the coolies, to prevent their absconding, which they always do if possible, being so afraid of cholera, and thereby prevent the epidemic becoming widespread.

Having decided to form such a camp, there are several points which have to be considered with regard to the choosing of the site.

(1) It is absolutely impossible to allow the infected trains to remain on the main line, so a siding has to be chosen, which must be large enough to accommodate all and also to allow for segregation of the infected wagons from the non-infected. Failing this a piece of ground large enough to encamp the coolies with a zone of safety between the infected and the non-infected tents.

(2) A good and plentiful water supply is an advantage, but if not available the difficulty can be overcome by making the coolies draw their water from the engines of their respective trains, provided that there is a watering station within reasonable distance of the camp, where the engines can replenish their supply.

(3) The site chosen must be in a sparsely populated area. If put near a town or village the inhabitants will immediately raise a hue and cry. In this respect an unimportant branch line is the most suitable situation.

(4) Food must be available for the coolies.

In choosing the site for our camp we were fortunate, inasmuch as we were able to utilize a large stores siding on one of the branch lines, which conformed with the above. The ground was rather low-lying, but the whole of this part of Bengal is much the same. In fact, some parts of it are below sea-level. The siding was situated some 20 miles from the place where the coolie trains were working.

Immediately the site was chosen orders were given for the trains to proceed there at once, for cholera huts to be constructed, for latrines to be dug and for the water supply to be guarded to prevent pollution by the infected coolies.

Two of the trains got to the camp without any trouble, but the coolies from the third train got down at one of the stations and refused to go back to the train. After a good deal of persuasion, they again boarded the train and it proceeded to its destination without any further hitch.

As each train arrived at the camp the infected wagons were uncoupled and shunted into one siding and the non-infected were put into another.

The whole of the camp was surrounded by a cordon of police to prevent the coolies from absconding. A certain number of them did manage to get away, but the number was negligible.

PROPHYLAXIS AND TREATMENT.

The coolies had to a certain extent been treated while the trains were on the line, but this was augmented as soon as they arrived at the camp.

NON-INFECTED.

Every non-infected coolie was given 1 oz. of the following mixture twice daily:—

℞	Acid Sulph. dil.	...	15 m.
	Tr. Opii ...	...	10 m.
	Aq. Chlorof. ad	...	1 oz.

The issuing of this medicine was a very fatiguing job, as every man, woman and child made it his business to be as stubborn about taking the medi-

cine as possible. The difficulty of the situation was also increased owing to the fact that these people speak a very different language from the ordinary Hindustani, and only one man among us could converse with them. However, after a great deal of trouble we managed to convince them that the medicine would make them less liable to be attacked with cholera, and then they took it without any trouble.

These coolies were made to take the tarpaulins off their wagons and use them to make tents. The tarpaulin was supported by three pieces of bamboo, two upright and one across and pegged to the ground at the edges. In this way a sort of large-sized bivouac was formed for each coolie and his family, the ground inside being covered by another tarpaulin. Here I may say that luck was with us, as if it had rained we would have been in a predicament, as the tents were by no means weatherproof.

The wagons were then thoroughly disinfected with izal and then exposed to the sun to complete the disinfection.

We had one accident with the tents. A coolie and his family were sleeping in a tent with a brazier burning inside and in the morning we found six of them suffering from CO poisoning. However, they recovered and were none the worse for it.

Arrangements had to be made for feeding these coolies, so we fixed what we considered to be a fair ration for a man, a woman and a child, and having calculated the quantity of food required for each train we issued this to the headmen, who in turn distributed the food to the coolies. Rice, dhal, oil, potatoes, spices and tobacco or cigarettes were distributed among them every day. The quantity supplied was more than sufficient, they being better fed than they had ever been in their lives before, but they were not satisfied, as the rations did not include native liquor, of which they are very fond.

Infected.

These gave us far more trouble than the others. They refused to go into the cholera huts which had been erected for them, as these huts were supposed to harbour ghosts. We tried to persuade them to do so, but they still refused; so, seeing that they were adamant, we decided to leave them in their wagons and treat them there. Here they were treated in as good a manner as could be expected under these conditions.

They gave a certain amount of trouble over the taking of their medicine, but when we attempted to give them saline they made a terrible fuss. Intravenous saline was attempted, but it had to be abandoned, as the patients and their relatives created so much disturbance. The Sonthals are very much against operative treatment in any form. We then tried subcutaneous saline. It was only by holding the patient and getting it in as quickly as possible that this was managed, but we succeeded in the majority of cases. A dirty ballast wagon is not an ideal situation in which to undertake the giving of saline, but in this case there was no other alternative. A certain number refused all treatment, and all the deaths which occurred in the camp, except one, belonged to this category. Every patient to whom saline was given recovered, and many of these were in a very bad state when treated.

As regards feeding, they were all given plain barley water during the acute stage and milk diet was available for them afterwards, but immediately they got over the acute stage they ate their ordinary food. It was useless to try to prevent their doing so. We tried but we failed.

Results.

Taking into account the difficulties with which we had to contend, the results were, on the whole, highly satisfactory. There were in all 40 cases, of whom 17 died.

They were divided among the trains as follows:—

	Complement	Cases	Deaths	Cured
Train No. 1 ...	167 coolies ...	16 ...	11 ...	5
,, 2 ...	187 ,, ...	11 ...	5 ...	6
,, 3 ...	175 ,, ...	13 ...	1 ...	12
Total ..	529 ,, ...	40 ...	17 ...	23

Of the above, 34 cases occurred before the trains were sent to the camp, and 12 of them had died before the trains arrived there.

	Cases	Deaths
Train No. 1 ...	13 ...	7
,, 2 ...	9 ...	4
,, 3 ...	12 ...	1
Total ...	34 ...	12

There were 22 cases on the trains when they arrived at the camp. Most of these were given treatment, but a few refused it and 3 of these died. One of the number who were treated also died.

The first day after arrival in camp there were 3 fresh cases, no deaths.

The second day there were 3 fresh cases, 1 death.

The third, fourth, fifth and sixth days there were no fresh cases, and so on the seventh morning the non-infected coolies were allowed to go to their homes, after each coolie had thoroughly washed his clothes in water to which a disinfectant had been added.

The convalescents were kept until they were fit to travel. This took until the morning of the tenth day, when they were also sent to their homes.

The figures in this outbreak show that the only method of treatment under conditions such as these is immediate segregation. Train No. 1, which was the longest time after infection in reaching the camp, shows the most deaths (11). Train No. 3, which was the shortest time after infection in reaching the camp, shows the least (1).

The whole epidemic subsided 48 hours after the trains were segregated in the camp.

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THE JOURNAL OF

Tropical Medicine and Hygiene

JULY 1, 1926.

THE DIAGNOSIS OF TROPICAL FEVERS.

THE accurate diagnosis of a tropical fever may be a comparatively simple matter, or it may, on the other hand, present almost insuperable difficulties, taxing the diagnostic acumen of even the most experienced practitioner to the utmost, even when supported by every aid that specialized methods of examination can provide.

In the first place, a complete and systematic clinical examination of every febrile patient is most essential, and he should be most carefully examined in every organ and every part of the body, from the crown of the head to the soles of the feet. It is the sum total of the various symptoms, none of which are alone pathognomonic, on which the diagnosis is established, and, along with the symptomatology, support for the diagnosis may also be sought from the results of laboratory investigations, the application of X-rays, and other special methods. The importance of clinical methods, however, cannot be overestimated, and it has even been suggested that a practitioner who is unable to form a diagnosis in such cases without the assistance afforded by the results of laboratory investigations should utilize his earliest spare moments in pursuing a course of post-graduate instruction in clinical methods. At the same time laboratory work should never be omitted as a check to confirm or to adjust the clinical diagnosis. It is essential also that the material submitted for examination in the laboratory should be properly collected with all the requisite precautions and should be transmitted to the laboratory without delay.

The collection of this material should always be made, or at least supervised, by the practitioner; it should not be left entirely to subordinates, otherwise unsuitable material may be sent and misleading reports returned. Clear and definite instructions should also be sent as to the nature of the examination required, together with a brief statement of the salient features of the case and the suspected clinical diagnosis.

It must, of course, always be ascertained that the thermometer reading on which the recognition of the febrile condition is based is an accurate index of the body temperature of the patient, and the various thermometrical fallacies have been considered and ruled out. Thus the fact that hot or cold substances have recently been placed in the mouth may give rise to fallacious readings. Again, when working in high air temperatures, the clinical thermometer, being of the maximum type, will rapidly rise to the temperature of the external air and remain thereat. Under such conditions the thermometer should be taken out of cold water and then placed in the patient's mouth, where it should remain sufficiently long to be raised to the actual temperature; it should then be quickly replaced in the cold water, in which it is examined and the reading taken.

The fevers encountered in the tropics may be classified, according to their duration, into acute and chronic, and the acute fevers may, for diagnostic purposes, be divided into those which have been in progress less than eight days and those which have lasted eight days or more when seen by the practitioner.

Acute fevers of less than eight days' duration

may or may not exhibit some striking physical sign. The physical signs to be considered include traumatisms, skin eruptions—whether erythematous, papular, urticarial, purpuric, vesicular, bulbous, pustular, or pigmented; derangement of some bodily system—whether elementary, respiratory, circulatory, urinary, generative, lymphatic, muscular, osseous connective tissue, or nervous; and those in which the signs and symptoms are associated with some organ of the body, and the condition and functions of the following organs should be carefully investigated in this connection, namely, spleen, liver, kidneys, pancreas, parotid and suprarenal capsules.

Fevers of more than eight days and less than six weeks' duration may be classified according to the type of fever present, whether intermittent, remittent, or continuous, and whether marked physical signs are present or absent.

The various laboratory investigations that may be undertaken to help in the elucidation of this condition call for the resources of a well-equipped laboratory. Microscopic examination of well-made blood films and of fæces, sputum, and other secretions, blood- and stool-cultures, serological examinations, including the methods of agglutination, complement-fixation, and bacteriolysis, microscopic, bacteriological and chemical examination of the cerebro-spinal fluid, and many other biochemical investigations may be called upon to furnish results. X-ray examinations may also be used to throw light on the condition of the various organs, especially those within the chest. Lastly, the therapeutic test may be made use of.

A fever of syphilitic origin yielding to the administration of mercury and iodides, one due to malaria to quinine, &c., whilst atropine has been employed in the differentiation of fevers belonging to the enteric group. F. E. T.

Salmon in a diet for the Prophylaxis of Goitre (N. D. Jarvis, R. W. Clough and E. D. Clark, *Journal of the American Medical Association*, May 1, 1926).—In a group of susceptible persons just as great or greater immunity was produced with three as with five injections of scarlet toxin. The dosage suggested by the findings is 500, 5,000 and 30,000 skin test doses respectively, with an interval of two weeks between injections. This method of immunization is now in routine use in Michigan state institutions. The time interval of two weeks is considered important as there seems to be less systemic reaction and greater immunity produced than with the usual one week interval. Clinical and laboratory findings showed no injurious effects on the subject following the relatively large dose of toxin used in the third injection. This investigation is being continued on a larger scale.

Current Literature.

INDIAN MEDICAL GAZETTE,

March, 1926.

Differential Diagnosis in the Tropics (A. H. Proctor).—This paper is written in the hope of helping practitioners in the tropics where diseases, which in other countries are straightforward, are nearly always complicated, and therefore difficult to diagnose. Malaria, one of the commonest of tropical diseases, is very often associated with dysentery, cholera, respiratory conditions and many others. Of 426 cases admitted to hospital for various affections, the diagnosis of malaria was only arrived at after a stay in hospital. In cases of vomiting, the blood should always be examined for malaria parasites, or examination of the spleen should be made. Kala-azar is the next on the list with frequent complications, and is very often erroneously diagnosed as enteric fever. Points of value in the differentiation of these two diseases are, firstly, the spleen steadily enlarges with the duration of the fever in kala-azar and as a rule it reaches a larger size than it does in enteric. Secondly, the general condition of the patient is, as a rule, less toxic than the duration of the fever would lead one to suspect. Thirdly, there is progressive leucopenia, so that the proportion of white cells to red cells falls below 1 in 1,000. Fourthly the double rise in twenty-four hours. Malignant endocarditis is also commonly mistaken for kala-azar. Affections by *Entamœba histolytica* are commonly associated with diarrhœa and constipation and other affections, and in these cases a thorough examination of the stool is necessary. It should also be borne in mind that many tropical diseases present themselves in atypical forms which mimic other diseases. Other diseases, such as ankylostomiasis, leprosy, schistosomiasis, &c., will be discussed at a later date.

The Treatment of Lacerated Wounds within Two Hours (R. J. L. Sladen).—This method is ideal from an economical point of view; it is used in all the hospitals of the G.I.P. Railway, and the railway staff, amongst whom lacerated wounds are of frequent occurrence, are enabled to return to their duties after a very short absence from work. The treatment is carried out on the following lines: (1) To stop all hæmorrhage. (2) Place a sterile swab over the wound. (3) After thoroughly washing the hands with hot water, soap and a nail-brush wash the surrounding skin for at least 18 in. around the wound with the same. (4) Wash the wound in every crevice with hot water and soap. Nos. 3 and 4 may be left out unless the wound is very dirty. (5) Cut away loose tags of muscles and skin with sterilized scissors and forceps. (6) Wash every crevice with spirit applied with a sterilized swab. Paste every portion of the wound with B.I.P.P. (liquid paraffin 1 oz., bismuth subnitrate 1 oz., iodoform 2 oz.) applied with a sterile swab, taking care to leave very little in the depth of the wound. (8) Sew up the wound. Apply tincture of iodine and dress with dry steri-

lized gauze or lint. (9) An anæsthetic is nearly always necessary. (10) There is frequently a rise of temperature which does not necessarily indicate that the wound is not doing well. (11) The dressings may be left on up to a week if there is no local pain, but should be otherwise removed sooner. There is no harm in daily dressing provided the wound is kept dry and sterilized dressings applied. When redressing, keep the wound dry, use Friar's balsam, tincture of iodine or methylated spirit. (12) Iodoform poisoning may possibly occur, but has been most unusual.

Bombay Millponds and Anopheline Control (P. A. Dalal).—From this study it would appear that Paris green affords an ideal adjunct to anti-anopheline work. In the cases of large sheets of impounded water, as ponds and tanks and large swamps, where the use of oil or other larvicide would be enormously expensive and therefore impracticable, Paris green would appear to be a most valuable remedy to adopt. It is stated that domestic animals come to no harm by drinking the water of ponds treated with Paris green and that fish also are not killed by its use.

On the Inefficiency of "Mercurochrome 220" in the Treatment of Malaria (J. D. Dundas and D. M. Telang).—Treatment of six cases of malaria with "Mercurochrome 220" has given very unsatisfactory results. It had no effect on the malaria parasites even after two doses, and stomatitis and ptyalism were marked features in every case. The drug appears to irritate the kidney tissue to the extent of producing mild nephritis. It certainly cannot be claimed as an equal to quinine in the treatment of malaria.

Indian Digitalis (R. N. Chopra and Premankur De).—Digitalis is used in large quantities in India by the medical profession, but most of it is imported, and it was with a view to seeing whether preparations could be made from the Indian leaf that these investigations were carried out. The imported digitalis preparations are liable to lose 20 to 40 per cent. of their potency in a short time, besides being an economic problem. The digitalis leaf of good quality grows on the valley of Kashmir, Northern Himalayas, and at Mungpoo, Eastern Himalayas. The leaf grown in the Nilgiri Hills is not so good when tested by biological assay. Further clinical trials are recommended before the leaf can be finally condemned. The negative effect on the mammalian heart under experimental conditions may be overshadowed by the muscle poison effect, and it is suggested that this may not occur when the drug is given by the mouth. Improvements in methods of drying and storage are recommended to get a uniform quality.

Congenital Yaws (B. N. Bandyopadhyay).—Contrary to general opinion, the author thinks that many of the cases of yaws in infants are of a congenital nature. During the last six years he has come across the disease in the Native Civil Hospital, Kakemega, Kenya Colony, in people of all ages from 2 days to 80 years. In one case the baby was 2 weeks old and the mother had suffered from yaws six months previously and was treated by the author. The father had had syphilis six years previously. He had two healthy children born of his first wife, and the baby in question suffering from yaws was the child of his second wife. This case is considered of probable congenital transmission.

Medical News.

NORTH PERSIAN FORCES MEMORIAL MEDAL.

Dr. W. Corner, O.B.E., M.D., Iraq Health Service, has been awarded the North Persian Forces Memorial Medal for the year 1925 for his paper "Malaria in the Kirkuk Division of Northern Mesopotamia during 1923," published in the *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 1925, vol. 19, Nos. 1 and 2, pp. 41-69.

This is the third award of the medal, which, in accordance with the terms of the Trust Deed of the Memorial Fund, is awarded annually for the best paper on Tropical Medicine or Hygiene published in any journal during the preceding twelve months by any medical officer of under twelve years' service of the Royal Navy, Royal Army Medical Corps, Royal Air Force, Indian Medical Service or of the Colonial Service, provided the Memorial Committee consider that any of the papers published has attained a standard of merit justifying an award.

Correspondence.

To the Editor of the JOURNAL OF TROPICAL MEDICINE AND HYGIENE.

SIR,—Professor Ziemann's note (objecting to my review on his "Malaria and Blackwater Fever,") published in English in the JOURNAL OF TROPICAL MEDICINE AND HYGIENE of March 15, 1926, was submitted in German to the Editor of the *Tropical Diseases Bulletin*, for his private (persönlich) information. On its unexpected appearance elsewhere I have with care reconsidered the original volume, my review thereon which Professor Ziemann has seemingly imperfectly understood, and his own published note.

Taking into full consideration the often unpleasant duty which an honest critic owes to the *Bulletin's* readers and his obligation towards the author to furnish no criticism that is not fair and just, I have reached the deliberate opinion that the notice, to which objection is taken, requires no alteration. With confidence I leave this conclusion in the hands of such as are sufficiently interested in the matter to undertake the requisite comparisons for themselves.

I am,

"*Heathfield*," Yours truly,
Castlebar Park,
Ealing, *W.* 5. CLAYTON LANE.
April 8, 1926.

Original Communication.

FURTHER OBSERVATIONS ON A MYCOLOGICAL METHOD TO IDENTIFY VARIOUS SUGARS AND OTHER CARBON COMPOUNDS.

By ALDO CASTELLANI, C.M.G., M.D., F.R.C.P.,

AND

F. E. TAYLOR, M.D., F.R.C.S., D.P.H.

IN several of the best known manuals of pathology and clinical methods, it is stated that the fermentation test by means of baker's yeast is the only absolutely certain and specific test for glucose.

Since 1904, one of us (A.C.) has called attention to the fallacy of this statement on various occasions, and some years ago we published a paper in which we described a mycological method for the detection of glucose and other carbon compounds, first theoretically devised by one of us (A.C.) in Ceylon. Our results were confirmed by various authorities. Of eight samples of baker's yeast obtained in various quarters of London, and places near London, the following results were obtained:—

Sample 1, when inoculated directly with sugar peptone waters, fermented with production of gas, glucose, levulose, maltose, galactose, saccharose, dextrin, lactose, adonitol, inulin, sorbite, dulcitol, mannitol, raffinose, arabinose, salicin, amygdalin, isodulcitol, erythrite and glycerol.

Sample 2, fermented with production of gas, glucose, levulose, lactose, maltose and saccharose.

Sample 3, fermented with production of gas, glucose, levulose, maltose and galactose; it produced acid but no gas in lactose.

Sample 4, fermented with production of gas, glucose, levulose, maltose, galactose, saccharose, lactose, inulin and dextrin.

Sample 5, fermented with production of gas, glucose, levulose and maltose.

Sample 6, fermented with production of gas, glucose, levulose, maltose and galactose.

Sample 7, fermented with production of gas, glucose, levulose, maltose, galactose, saccharose and lactose.

Sample 8, fermented with production of gas, glucose, levulose, maltose, galactose, saccharose, dextrin, lactose, adonitol, inulin, sorbite, dulcitol, mannitol, raffinose, arabinose, salicin, amygdalin, isodulcitol, erythrite and glycerol.

Usually the ordinary samples of baker's yeast, as shown by one of us (A. C.) some years ago, are not pure; they consist of one or two species of saccharomyces, with almost constantly a Gram-positive bacillus and other bacteria. We therefore obtained cultures of pure yeast from the laboratories of well-known yeast firms. Of three cultures so obtained, one fermented with the production of gas, glucose, levulose, galactose and saccharose; the other two fermented maltose in addition to these sugars.

When urine is fermented by baker's yeast we cannot, therefore, come definitely to the conclusion that the fermentable substance is glucose; it might be galactose, maltose, or other sugars. To detect glucose, recourse should be made to really specific germs for that sugar; i.e., germs that will ferment glucose only with the production of gas and no other carbohydrate.

Such organisms exist but are extremely rare, because, in our experience, when an organism ferments glucose, with the production of gas, it will, as a rule, also ferment levulose and frequently other sugars and carbohydrates. One of the few germs that ferment glucose only, with production of gas, is *Monilia balcanica*, found by one of us (A.C.) some years ago; this monilia we unfortunately lost, together with other interesting fungi, in an accidental fire.

In the absence of *Monilia balcanica*, the next best organism to use instead of ordinary yeast is *Monilia krusei* Castellani. This monilia ferments, with the production of gas, glucose and levulose only. If a urine is fermented by it, we can conclude with certainty that it contains either glucose or levulose, or a mixture of the two. For practical purposes, therefore, it is much more suitable than baker's yeast which will, as a rule, ferment a large number of sugars, including maltose, galactose, saccharose and lactose.

MYCOLOGICAL METHOD TO IDENTIFY VARIOUS SUGARS AND OTHER CARBON COMPOUNDS.

As stated in previous publications, we do not possess specific germs for each substance, microorganisms which will ferment maltose, galactose or inulin only, but as there are a number of species of hyphomycetes and bacteria which select certain carbohydrates to the exclusion of others, we have found it possible, by using certain of these hyphomycetes and bacteria and comparing the results, to devise a general method. To understand the working of the method it is necessary to keep in mind the biochemical fermentative characters of certain fungi and bacteria, which are collected in table 1.

We will limit ourselves to describing briefly the identification and detection of maltose, galactose and inulin, and we will also give a list of the principal mycological formulæ we have devised and employed in the identification of various other carbon compounds.

Identification of Maltose.—In order to determine whether a given substance is maltose or not, a sterile 1 per cent. solution in sugar-free peptone water is made and distributed into two tubes, each containing a Durham's fermentation tube or similar appliance. One of the following procedures is then used:—

(*A*) A 1 per cent. sterile solution in sugar-free peptone water is made of the substance to be tested for maltose. The solution is distributed into two tubes, which are labelled 1 and 2. Tube 1 is inoculated with *Monilia tropicalis* and tube 2 with *Monilia macedoniensis*, or other monilias of the same group (*Monilia macedoniensoides*). If, after four days' incubation at 37° C., tube 1 contains gas and tube 2 does not, we can come to the conclusion that the substance is maltose. This is easily understood if we keep in mind the biochemical reactions of the two monilias. *Monilia tropicalis* ferments, with the production of gas, the following substances: glucose, levulose, galactose, maltose and saccharose. *Monilia macedoniensis* and all other monilias of the macedoniensis group (*Monilia macedoniensoides*, &c.) ferment, with the production of gas, the following carbon compounds: glucose, levulose, galactose, saccharose and inulin. The substance we are investigating has been fermented, with the production of gas, by *Monilia tropicalis*. It can be, therefore, only glucose, levulose, maltose, galactose or saccharose; but if

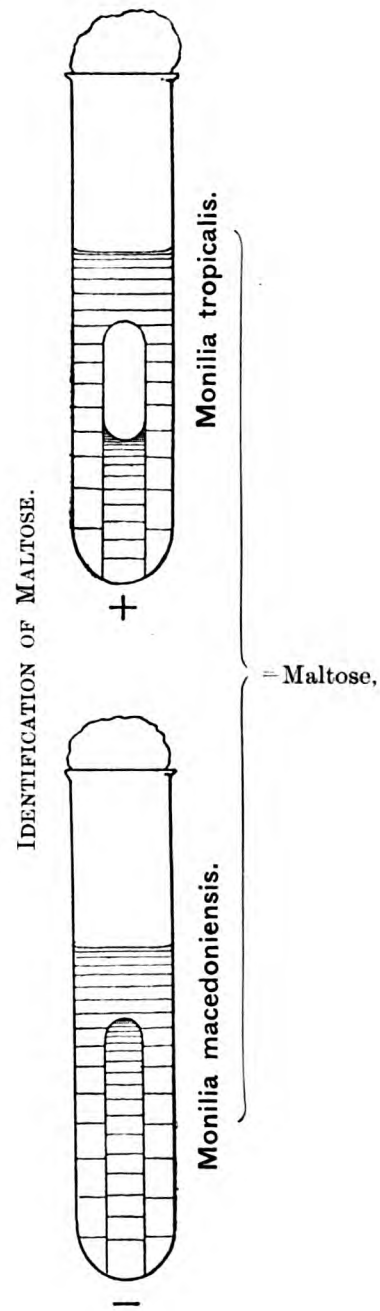
TABLE I.—FERMENTATIVE CHARACTERS OF CERTAIN MONILIAE AND BACTERIA.

	Glucose	Levulose	Maltose	Galactose	Saccharose	Lactose	Mannitol	Dulcitol	Dextrin	Raffinose	Arabinose	Adonitol	Inulin	Sorbitol	Starch	Glycerol	Inositol	Salicine	Amygdalin	Isodulcitol	Erythrytol
Monilia balcanica Castellani	+	+	O	+	O	O	+	+	+	+	+	O	O	+	O	+	O	+	O	+	O
Monilia krusei Castellani	+	+	+	+	O	O	+	+	+	+	+	O	O	+	O	+	O	+	O	+	O
Monilia pinoyi Castellani	+	+	+	+	O	O	+	+	+	+	+	O	O	+	O	+	O	+	O	+	O
Monilia metalondinensis Castellani	+	+	+	+	+	O	+	+	+	+	+	O	O	+	O	+	O	+	O	+	O
Monilia tropicalis Castellani	+	+	O	+	O	O	+	+	+	+	+	O	O	+	O	+	O	+	O	+	O
Monilia rhoi Castellani	+	+	+	+	+	O	+	+	+	+	+	O	O	+	O	+	O	+	O	+	O
Monilia bronchialis Castellani	+	+	O	+	O	O	+	+	+	+	+	O	O	+	O	+	O	+	O	+	O
Monilia macedoniensis (*M. macedoniensoides*) Castellani	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O
Bacillus coli communis Escherich, strain O ...	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O
Bacillus coli communior (**var.** *pseudo-coscoroba*) ...	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O
Bacillus paratyphosus B **var.** M. Schottmüller ...	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O
Bacillus paratyphosus A Schottmüller	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O
Bacillus columbensis Castellani	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O
Bacillus asiaticus Castellani, strain 3	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O
Bacillus pseudoasiaticus Castellani	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O
Bacillus morgani Castellani and Chalmers, strain S	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O
Bacillus orleanensis Castellani	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O
Bacillus metacarolinus Castellani	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	O	+	O	+	O

In the tables and in the mycological formulas + indicates gas; O = absence of gas; simple acid fermentation is not taken into account.

it had been glucose, levulose, galactose or saccharose, it would have been fermented with production of gas by *Monilia macedoniensis* also. Therefore, it can only be maltose.

Monilia tropicalis Castellani ... ... + } — Maltose.
Monilia macedoniensis Castellani ... O }



(*B*) Tube 1 is inoculated with *Monilia pinoyi* and tube 2 with *Monilia krusei*. The two tubes are placed in an incubator at from 35° to 37° C. for four days. If, after that time, tube 1 (*Monilia pinoyi*) contains gas and tube 2 (*Monilia krusei*) does not, we can come to the conclusion that the substance is maltose. This is easily understood by keeping in mind the fermentative reactions of the

monilias. *Monilia pinoyi* ferments, with the production of gas, the following compounds only: glucose, levulose, and maltose. *Monilia krusei* ferments, with the production of gas, glucose and levulose only. Our substance has been fermented, with the production of gas, by *Monilia pinoyi;* it can be only glucose, levulose or maltose, but if it had been either glucose or levulose it would have been fermented also by *Monilia krusei;* therefore, it can only be maltose.

(*C*) Tube 1 is inoculated with *Monilia metalondinensis* and tube 2 with *Monilia macedoniensis* or *Monilia macedoniensoides*. The two tubes are incubated at 37° C. for four days. If after that time tube 1 contains gas and tube 2 does not, the substance is maltose. This is explained by the fact that *Monilia metalondinensis* ferments, with the production of gas, only glucose, levulose, maltose and galactose; and *Monilia macedoniensis* only the following carbon compounds: glucose, levulose, galactose, saccharose and inulin. The substance we are investigating has been fermented by *Monilia metalondinensis*. It can be, therefore, only glucose, levulose, maltose or galactose; but if it were glucose, levulose or galactose, it would have been fermented also by *Monilia macedoniensis*. There is only one possibility left—it must be maltose.

Monilia metalondinensis Castellani ... + } = Maltose.
Monilia macedoniensis Castellani ... 0 }

Identification of Maltose when Present with Other Common Fermentable Substances (Glucose, Levulose, Galactose, Saccharose).—If a liquid is suspected of containing maltose mixed with glucose, levulose, galactose and saccharose, it is fermented with *Monilia macedoniensis* or *Monilia macedoniensoides*. If after exhaustion with *Monilia macedoniensis* the liquid is still fermented, with the production of gas, by *Monilia pinoyi, Monilia tropicalis* or *Monilia metalodinensis,* the conclusion is that the liquid also contains maltose. Strains of the various monilias should be used which have approximately the same fermentative power on the various carbohydrates they all ferment.

Identification of Galactose.—In determining whether or not a certain substance is galactose, the following procedures are used:—

(*A*) A 1 per cent. sterile solution of the substance is made in sugar-free peptone water and distributed into two tubes, each containing a fermentation tube. Tube 1 is inoculated with *Monilia metalondinensis* and tube 2 with *Monilia pinoyi*. If, after four days' incubation at 37° C. tube 1 contains gas and tube 2 does not, the substance must be galactose. The explanation lies in the fact that *Monilia metalondinensis* ferments only the following carbon compounds: glucose, levulose, maltose and galactose. *Monilia pinoyi* ferments only the following substances: glucose, levulose and maltose. The substance has been fermented by *Monilia metalondinensis*. It can be, therefore, only glucose, levulose, maltose or galactose. It has not been fermented by *Monilia pinoyi,* so it cannot be glucose, levulose or maltose. There is only one possibility left—it must be galactose.

Monilia metalondinensis ... ... + } = Galactose.
Monilia pinoyi ... ... 0 }

(*B*) The solution is distributed into three tubes, each containing a fermentation tube. Tube 1 is inoculated with *Monilia metalondinensis,* tube 2 with *Monilia krusei,* and tube 3 with *Monilia macedoniensis*. The three tubes are placed in an incubator at 37° C. for four days. If, after that period of time, tubes 1 and 3 contain gas and tube 2 does not, the substance is galactose.

This is easily explained by keeping in mind the biochemical reactions of the three fungi. *Monilia metalondinensis* produces gas only in glucose, levulose, maltose and galactose; *Monilia macedoniensis* produces gas only in glucose, levulose, galactose, saccharose and inulin; *Monilia krusei* produces gas only in glucose and levulose. The substance we are investigating has been fermented, with the production of gas, by *Monilia metalondinensis*. It can be, therefore, only glucose, levulose, maltose or galactose. It cannot be glucose or levulose, because in such a case it would have been fermented also by *Monilia krusei,* and it cannot be maltose, because it would not have been fermented by *Monilia macedoniensis*. There is only one possibility left—it must be galactose.

Monilia metalondinensis ... ... + }
Monilia krusei ... ... 0 } = Galactose.
Monilia macedoniensis ... ... + }

(*C*) The solution is distributed into three tubes: tube 1 is inoculated with *Monilia macedoniensis,* tube 2 with *Monilia krusei,* and tube 3 with *Bacillus paratyphosus* B. Schottmüller. If, after four days in the incubator at 37° C., tube 1 shows presence of gas, tube 2 shows absence of gas, and tube 3 shows presence of gas, we can come to the conclusion that the substance we are investigating is galactose. As the substance has been gas-fermented by *Monilia macedoniensis* it can only be glucose, levulose, galactose, saccharose or inulin; but it has not been fermented by *Monilia krusei,* therefore it cannot be glucose or levulose. It can only be galactose, saccharose or inulin, but if it had been saccharose or inulin it would have been fermented by *Bacillus paratyphosus* B. There is only one possibility left—it must be galactose.

Monilia macedoniensis Castellani ... + }
Monilia krusei ... ... 0 } = Galactose.
Bacillus paratyphosus B Schottmüller + }

(*D*) The solution is distributed into two tubes: tube 1 is inoculated with *Bacillus morgani* (strain S) and tube 2 with *Monilia krusei*. If, after three days in the incubator at 35° C., tube 1 contains gas and tube 2 does not, we can come to the conclusion that the substance is galactose.

This is easily understood by keeping in mind the fermentative reactions of the two germs. *Bacillus morgani* (strain S) ferments, with production of gas, only glucose, levulose and galactose, and *Monilia krusei* only glucose and levulose. The substance we are investigating has been fermented, with production of gas, by *Bacillus morgani;* it can only be glucose, levulose or galactose. It has not been fermented by *Monilia krusei;* it cannot, therefore, be glucose or levulose; it must be galactose.

Bacillus morgani Castellani and Chalmers + } = Galactose.
Monilia krusei Castellani ... ... 0 }

Identification of Galactose when Present with other Common Fermentable Substances (Glucose, Levulose, Maltose, Saccharose).—To detect galactose in a liquid in which it is suspected to be present together with glucose, levulose, maltose or saccharose, the liquid is inoculated with an organism which gas-ferments all the sugars we have mentioned except galactose, for instance *Monilia bronchialis*. If after exhaustion with *Monilia bronchialis* the liquid is still fermentable with *Monilia pinoyi* or *Monilia tropicalis,* the inference is that the liquid contained galactose in addition to other fermentable substances.

Identification of Inulin.—In determining whether a substance is inulin or not, a sterile 1 per cent. solution in sugar-free peptone water is made and distributed into two tubes, each containing a Durham's fermentation tube or similar appliance. The following procedure is then used:—

(*A*) Tube 1 is inoculated with *Monilia macedoniensis* or any other monilia of the same group, such as *Monilia macedoniensoides* or *Monilia chalmersi,* and tube 2 with *Monilia tropicalis*. The two tubes are placed in an incubator at from 35° to 37° C. for four days. If, after that time, tube 1 contains gas and tube 2 does not, we can come to the conclusion that the substance is inulin. This is easily understood by keeping in mind the fermentative reactions of the two monilias. *Monilia macedoniensis* and all other monilias of the same group ferment, with the production of gas, only the following carbon compounds: glucose, levulose, galactose, saccharose and inulin. *Monilia tropicalis* Castellani ferments, with the

production of gas, only glucose, levulose, maltose, galactose and saccharose.

Monilia macedoniensis Castellani ... + } = Inulin.
Monilia tropicalis Castellani ... ... 0 }

(*B*) Tube 1 is inoculated with *Monilia macedoniensis* Castellani and tube 2 with *Monilia rhoi* Castellani. The two tubes are placed in an incubator at from 35° to 37° C. for four days. If after that time tube 1 contains gas and tube 2 does not, we can come to the conclusion that the substance is inulin. This is easily understood when we remember that *Monilia macedoniensis* ferments, with the production of gas, only glucose, levulose, galactose, saccharose and inulin, and *Monilia rhoi* ferments, with the production of gas, only glucose, levulose, galactose and saccharose.

Monilia macedoniensis Castellani ... + } = Inulin.
Monilia rhoi Castellani ... ... 0 }

(*C*) Tube 1 is inoculated with *Monilia macedoniensis* and tube 2 with *Bacillus pseudocoli* or *Bacillus neapolitanus*, or any other strain of the communior group of *Bacillus coli* (ferment saccharose). The tubes are incubated at 37° C. for four days. If after that time tube 1 contains gas and tube 2 does not, we can come to the conclusion that the substance, according to all probabilities, is inulin, since glucose, levulose, galactose and saccharose would have been fermented also by *Bacillus pseudocoli* or *Bacillus neapolitanus* or any other strain of the *Coli communior* group.

Monilia macedoniensis Castellani... ... + }
Bacillus coli communior Escherich; } = Inulin.
Bacillus pseudocoli Castellani; *Bacillus neapolitanus* Emmerich, &c. ... ... 0 }

(*D*) Tube 1 is inoculated with *Monilia macedoniensis* Castellani and tube 2 with *Bacillus asiaticus* Castellani. The two tubes are placed in an incubator at 37° C. for four days. If after that time tube 1 contains gas and tube 2 does not, we can come to the conclusion that the substance, according to all probabilities, is inulin. This is easily understood by remembering the fermentative reactions of the two organisms. *Monilia macedoniensis* ferments only glucose, levulose, galactose, saccharose and inulin, with production of gas; while glucose, levulose, galactose and saccharose are also fermented by *Bacillus asiaticus;* the substance must, therefore, be inulin.

Monilia macedoniensis Castellani .. ... + } = Inulin.
Bacillus asiaticus ... . 0 }

Identification of Inulin when Present with other Fermentable Substances.—If we suspect that a liquid contains inulin mixed with one or several of the following fermentable substances, viz., glucose, levulose, maltose, galactose, saccharose, mannitol, lactose, dextrin, raffinose, arabinose, sorbitol, glycerol, salicine and isodulcitol, we can ascertain its presence in the following manner: The liquid is fermented with *Bacillus coli communior*. If, after exhaustion with *Bacillus coli communior* the liquid can still be fermented with *Monilia macedoniensis*, with the production of gas, the inference is that it contained inulin. The precaution should be taken to select a strain of *Bacillus coli communior*, the fermentative power of which on glucose, levulose, galactose and saccharose is not less than that of *Monilia macedoniensis*.

Use of the Mycologic Method in Urine Analysis.

From numerous experiments we have carried out, by adding to samples of urine various sugars and other carbohydrates, and also from a fairly large number of pathological specimens, we have determined that the method can be used in urine analysis for the detection and differentiation of certain sugars and other carbon compounds, such as glucose, maltose, galactose, lactose and pentose, provided the amount of such substances present is not too minute (not less than 0·1 per cent.). The urine is distributed in sterile tubes, containing Durham's fermentation tubes or similar devices, or ordinary saccharometers may be used; they are inoculated with the organisms already mentioned. Two points of considerable importance are:—

(1) The urine must be aseptic; if it cannot be collected aseptically it should be sterilized as soon as possible, before or after distribution in the sterile tubes, by heating in Koch's steamer for thirty minutes; once is sufficient for practical purposes, but in special cases it may be heated on two or three consecutive days. It should never be autoclaved, as this procedure may alter the characters of the sugars and other carbohydrates present. Another procedure is to filter the sample of urine by means of a Chamberland or a Berkefeld filter.

(2) It is of great advantage to add a third or an equal amount of peptone water to the urine, otherwise the organisms may, at times, grow very scantily, and there may be no distinct production of gas.

If a urine is Fehling-reducing, we can determine which of the commonest sugars found in pathological urines is present (glucose, levulose, maltose, galactose, lactose, pentose) by the following procedure:—

The urine is distributed into six tubes, each containing a Durham's fermentation tube. They are labelled 1, 2, 3, 4, 5 and 6. Tube 1 should be inoculated with *Monilia balcanica* Castellani, or *Monilia parabalcanica* Castellani; tube 2 with *Monilia krusei* Castellani; tube 3 with *Monilia pinoyi* Castellani; tube 4 with *Monilia metalondinensis* Castellani; tube 5 with *Bacillus coli communior* Escherich, and tube 6 *Bacillus paratyphosus* B Schottmüller.

After the tubes are incubated at 35° C. for four days, the results are read:—

(1) If in tubes 1, 2, 3, 4, 5 and 6 gas is present, the reducing substance is glucose.

(2) If tube 1 contains no gas, and in tubes 2, 3, 4, 5 and 6 gas is present, the reducing substance is levulose.

(3) If tubes 1 and 2 contain no gas, and in tubes 3, 4, 5 and 6 gas is present, the reducing substance is maltose.

(4) If tubes 1, 2 and 3 contain no gas, and in tubes 4, 5 and 6 gas is present, the reducing substance is galactose.

(5) If tubes 1, 2, 3 and 4 contain no gas, and in tubes 5 and 6 gas is present, the reducing substance is pentose.

(6) If tubes 1, 2, 3, 4 and 5 contain no gas, and in tube 6 gas is present, the reducing substance is lactose.

(7) If none of the tubes contains gas, the reducing substance belongs to the non-fermentable group of reducing substances, including uric acid, creatinine, hippuric acid, and others.

Presence in the Urine of More Than One Reducing Substance.—If the presence of more than one sugar and other carbohydrates is suspected, this may, to a certain extent, be ascertained and the various carbohydrates determined by our mycological method. If the urine, for instance, after exhaustion with *Monilia krusei* is still fermented by *Monilia tropicalis* or *Monilia metalondinensis*, but not by *Monilia macedoniensis*, we

may come to the conclusion that the urine contained maltose in addition to glucose or levulose or both. If the urine after exhaustion with *Monilia balcanica* is still fermented by *Monilia krusei*, the inference is that the urine contained levulose in addition to glucose. If after exhaustion first with *Monilia balcanica* Castellani and then with *Monilia krusei* Castellani the urine is fermentable, with production of gas, by *Bacillus morgani* Castellani and Chalmers, the presumption is that it contained three sugars—glucose, levulose and galactose. The explanation is found in the fact that with regard to Fehling-reducing substances, *Monilia balcanica* Castellani ferments, with the production of gas, glucose only; *Monilia krusei* Castellani, glucose and levulose; *Bacillus morgani* Castellani and Chalmers, glucose, levulose and galactose. If a Fehling-reducing urine after exhaustion with *Monilia krusei* is capable of being fermented by *Bacillus coli* and not by *Bacillus paratyphosus* B, the inference is that the urine contained lactose in addition to glucose or levulose or both.

TABLE 2.—IDENTIFICATION OF CERTAIN FEHLING-REDUCING SUBSTANCES.

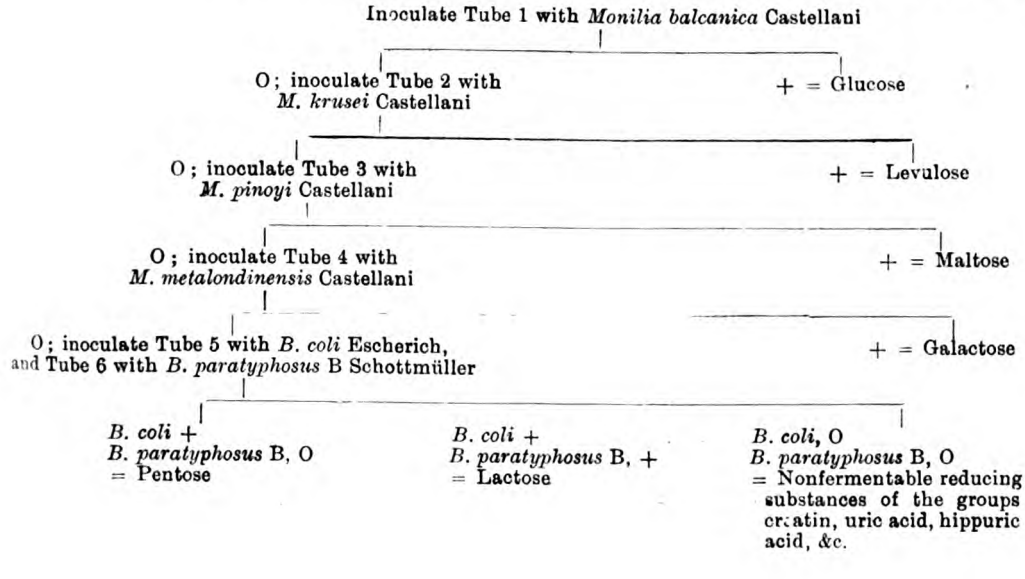
Monilia balcanica Castellani	*Monilia krusei* Castellani	*Monilia pinoyi* Castellani	*Monilia metalondinensis* Castellani	*Bacillus paratyphosus* B Schottmüller	*Bacillus coli* Escherich	[1] Reducing substance.
+	+	+	+	+	+	Glucose
0	+	+	+	+	+	Levulose
0	0	+	+	+	+	Maltose
0	0	0	+	+	+	Galactose
0	0	0	0	+	+	Pentose
0	0	0	0	0	+	Lactose
0	0	0	0	0	0	Nonfermentable reducing substances of the groups creatinine, hippuric acid, uric acid, &c.

[1] The reducing substance is made into a 1 per cent. peptone water solution. Selected strains of the various organisms with permanent biochemical reactions and producing a large amount of gas should be used.

Maltosuria.—Maltose, as is well known, reduces Fehling and cases of maltosuria have naturally been mistaken for true glycosuria. For the detection of maltose, the urine is obtained aseptically by catheter, or if this is not feasible is collected in a sterile receptacle and distributed at once in sterile tubes, each containing a small fermentation tube. The tubes are sterilized in Koch's stove for thirty minutes once or twice at an interval of six hours. This, in our experience, is generally sufficient, but at times it is advisable to repeat the sterilization in Koch's stove on two or three consecutive days. The urine should never be autoclaved, as this procedure may alter the composition of the sugars and other carbohydrates present. The urine freshly passed may also be filtered through a Chamberland instead of being sterilized. The tubes of aseptic urine are inoculated with the monilias, as explained above. If it is suspected that maltose is present in conjunction with other fermentable substances, such as glucose, levulose and galactose, the urine is exhausted with *Monilia macedoniensis*. If, after exhaustion with *Monilia macedoniensis*, the urine is still fermentable when inoculated with *Monilia tropicalis* or *Monilia metalondinensis* or *Monilia pinoyi*, we can come to the conclusion that the urine contains maltose in addition to other fermentable substances.

Illustrative Case.—Among the several cases of maltosuria we have come across we may quote the following which we observed a few years ago: Englishman, aged 47, tea planter. Has been a heavy beer drinker for many years. He is feeling quite well, except that his stoutness

TABLE 3.—KEY TO THE IDENTIFICATION OF CERTAIN FEHLING-REDUCING SUBSTANCES.



makes it difficult for him to go for long walks, and this interferes with his duties. A Fehling-reducing substance was found in his urine several times during the previous five years by various doctors, and he was told that he had glycosuria and might develop true diabetes. He came to consult one of us. The urine was Fehling-reducing and was investigated for presence of the following Fehling-reducing carbohydrates: glucose, levulose, galactose, maltose, lactose, pentose. The patient passed urine, in our presence, into two sterile vessels; the urine of the second vessel was distributed immediately by means of a sterile pipette into five tubes of peptone water (two parts of urine to one of peptone water), each containing a fermentation tube. The tubes were labelled Nos. 1 to 5. No. 1 was inoculated with *Monilia krusei* Castellani, No. 2 with *Monilia pinoyi* Castellani, No. 3 with *Monilia metalondinensis* Castellani, No. 4 with *Bacillus coli* Escherich, and No. 5 with *Bacillus paratyphosus* B Schottmüller. The five tubes were placed in the incubator at 37° C. for four days. On examination the results were as follows:—

Tube No. 1	(*Monilia krusei*)	O
,, 2	(*Monilia pinoyi*)	+
,, 3	(*Monilia metalondinensis*) ...	+
,, 4	(*Bacillus coli*)	+
,, 5	(*Bacillus paratyphosus* B) ...	+

This result according to our method means presence of *maltose*. The urine was gas-fermented by *Monilia pinoyi* and not by *Monilia krusei*. *Monilia pinoyi* produces gas only in three carbon compounds, viz., glucose, levulose and maltose. The urine therefore must contain either glucose or levulose or maltose or a mixture of these various sugars, but if the urine contained either glucose or levulose it would have been gas-fermented also by *Monilia krusei*. The sugar present must therefore be maltose. We may add that the result obtained by our mycological method was confirmed by the carrying out of purely chemical methods by a well-known chemist.

Lactosuria.—Next to glucose, lactose is the commonest sugar found in the urine. It is frequently met with in the urine of nursing mothers. Lactose, as is well known, reduces Fehling's solution, and not infrequently lactosuria has been mistaken for true glycosuria. It is most important to distinguish between the two conditions, as lactosuria is not a very serious condition, while glycosuria especially in nursing women, is of grave prognosis. The chemical detection and determination of lactose is difficult for an ordinary medical man. In most text-books it is stated that if a urine reduces Fehling, and is not fermented by ordinary baker's yeast (so-called German yeast), the presumption is that the reducing substance is lactose. There are, however, two very important sources of error.

First, quite a number of specimens of baker's yeast ferment lactose in addition to glucose, maltose and other sugars; second, even if the baker's yeast should not ferment lactose, this is not the only Fehling-reducing substance which may not be fermented by baker's yeast—pentose, for instance.

If a urine which reduces Fehling is not fermented by ordinary yeast we cannot, therefore, come to the conclusion that it is a case of lactosuria.

Detection and Determination of Lactose by the Mycological Method.—This method can be carried out in various ways. Herewith a few mycological formulæ as examples.

I.—In a Fehling-reducing urine, for practical purposes, the following formula is correct:—

Bacillus coli Escherich	+	= Lactose.
Bacillus paratyphosus B Schottmüller ...	O	

Bacillus coli and *Bacillus paratyphosus* B, besides lactose differ in their action on raffinose and salicin and glycerol, but raffinose and salicin are not carbon compounds found in the urine and at any rate they are not Fehling-reducing. The same formula applies to raffinose, salicin and glycerol, but there are substances which are of very rare occurrence in the urine and, moreover, they are not Fehling-reducing, and therefore this formula may be considered to be specific for practical purposes.

II.—*Bacillus neapolitanus* Emmerich ...	+	= Lactose.
Bacillus pseudoasiaticus Castellani	O	

The explanation lies in the fact that *Bacillus neapolitanus* and *Bacillus pseudoasiaticus* differ only in lactose as regards sugars and other carbohydrates found in pathological urines.

III.—*Monilia metalondinensis* Castellani	O	= Lactose (with great probability).
Bacillus coli Escherich	+	
Bacillus paratyphosus B Schottmüller	O	

The technical details for carrying out the test are identical with those already mentioned in connection with the search for maltose, &c.

Pentosuria.—Pentosuria is not a very rare condition. As is well known, the pentoses reduce Fehling well and Nylander solution very little; they give a positive reaction with Bial's and Read's modifications of the orcein test.

The mycological method can be used for the detection of pentose in a Fehling-reducing urine according to the following formulæ:—

Monilia tropicalis	O	= Pentose (generally arabinose).
Bacillus coli Escherich	+	
Bacillus paratyphosus B	+	

Monilia metalondinensis	O	= Pentose (generally arabinose).
Bacillus coli Escherich	+	
Bacillus paratyphosus B	+	

Illustrative Case.—Some time ago one of us was consulted by a planter, 38 years of age, who had been sent home from a tropical country in the Far East, with the diagnosis of diabetes. His general condition, however, was fairly good, and he said he had not lost much weight. According to his statements he was not very thirsty or very hungry, nor did he feel very weak. He appeared, however, somewhat nervy and irritable, and was very worried at the idea of suffering from diabetes. The urine passed during the twenty-four hours varied between three and four pints. It was slightly acid, density 1,020. It persistently reduced Fehling well, and apparently the diagnosis of diabetes had been based on this fact.

The urine was examined by the mycological method for presence of the following Fehling-reducing carbohydrates: glucose, levulose, galactose, maltose, pentose, lactose. The patient was made to pass urine into three sterile vessels; the urine of the second vessel was distributed immediately by means of a sterile pipette in six tubes of peptone water (about two parts of urine to one of peptone water), each containing a fermentation tube. The tubes were labelled Nos. 1 to 5. Tube 1 was inoculated with *Monilia krusei* Castellani; tube 2 with *Monilia pinoyi* Castellani; tube 3 with *Monilia metalondinensis* Castellani; tube 4 with *Bacillus coli* Escherich; tube 5 with *Bacillus paratyphosus*

B Schottmüller. The five tubes were placed in the incubator at 37° C. and examined after forty-eight hours. The following were the results :—

Tube 1	*Monilia krusei* Castellani	O
„ 2	*Monilia pinoyi* Castellani	O
„ 3	*Monilia metalondinensis* Castellani ...	O
„ 4	*Bacillus coli* Escherich	+
„ 5	*Bacillus paratyphosus* B Schottmüller ...	+

According to our method these results in a Fehling-reducing urine mean presence of pentoses.

The result obtained by our mycological test was confirmed by chemical investigation. The urine which reduced Fehling well and Nylander solution very little gave a positive reaction for pentoses with Bial's and Read's modifications of the orcein test. There can be very little doubt, therefore, that the patient was suffering from "pentosuria" and not from diabetes. It is important in practice to try to differentiate in every case between glycosuria and pentosuria, as the first condition is often of grave prognosis, while the second points to a much more benign disturbance of metabolism and practically requires no treatment. We are inclined to believe that our method will facilitate making such a differentiation a matter of routine.

Saccharosuria.—Spontaneous saccharosuria is an extremely rare condition, but artificial saccharosuria is not so rare among the malingerers. During the Great War we came across three cases in which saccharose had been added to the urine with the object of misleading the medical officer. The doctor who uses as routine the usual Fehling method is not apt to diagnose such cases as glycosuria, as saccharose does not reduce, at any rate not very clearly, Fehling's solution; but the medical man who uses what is considered, by most authorities, the more exact method of yeast fermentation will very likely fall into error, because though in so many textbooks it is stated that glucose is the only substance fermented by ordinary baker's yeast, we have found that a very large number of specimens of baker's yeast will ferment saccharose and also levulose, maltose, &c., in addition to glucose.

Mycological Tests to Determine Saccharose.—According to our method various tests may be evolved to determine whether a certain carbohydrate of those found in pathological urine is or is not saccharose; we give here a few of these tests in the convenient shape of mycological formulæ :—

I.—*Monilia metalondinensis* Castellani O
Monilia tropicalis Castellani ... + } = Saccharose.

This is explained by the fact that *Monilia metalondinensis* and *Monilia tropicalis* are identical in all their biochemical reactions except on saccharose, which is fermented with production of gas by *Monilia tropicalis* and not fermented by *Monilia metalondinensis*.

II.—*Monilia pinoyi* Castellani ... ... O
Monilia rhoi Castellani ... ... + } = Saccharose.

The explanation lies in the fact that *Monilia pinoyi* ferments with production of gas only glucose, levulose, maltose, and *Monilia rhoi* only glucose, levulose, maltose and saccharose. If a substance therefore is not fermented by *Monilia pinoyi* and is fermented with production of gas by *Monilia rhoi*, it must be saccharose.

To the above purely mycological formulæ we add a chemico-mycological formula which may be found useful in practice :—

Fehling ... ... O
Monilia tropicalis Castellani ... ... + } = Saccharose.

This is explained by the fact that *Monilia tropicalis* ferments with production of gas glucose, levulose, maltose, saccharose, and no other substance. If Fehling is negative it cannot be any of the first three substances, as they are all Fehling-reducing, and it must therefore be saccharose.

Detection of Saccharose when Mixed with Other Fermentable Substances.—Exhaust the urine with *Bacillus coli* Escherich *sensu stricto* (does not ferment saccharose), and later, after filtration through a Chamberland filter, or prolonged centrifugalization, inoculate it with *Monilia tropicalis*. If the urine is still fermentable the presumption is that in addition to other fermentable substances which can be found by our general method, the urine contains saccharose.

Inosituria.—Inosite, as is well known, does not reduce Fehling; it is not really a sugar, belonging to the aromatic series. It is not of very rare occurrence in the urine; it is, for instance, not infrequently found in diabetes insipidus, but the chemical methods of detecting it are far from easy or rapid. On the other hand, inosite, provided it is present in the urine in not too small a quantity, can be detected and determined with comparative ease by our mycological method.

Two tubes of urine collected aseptically or sterilized as already described, are mixed with one-third, or the same amount, of sugar-free peptone water and inoculated, No. 1 with *Bacillus paratyphosus* B Schottmüller (M variety, which ferments inosite), and No. 2 tube with *Bacillus paratyphosus* A Schottmüller (does not ferment inosite). The two germs, as regards carbohydrates and other pathological substances found in the urine, differ only in their action on inosite. Therefore, if, after forty-eight hours' incubation at 37° C., gas is present in No. 1 tube, and absent in No. 2 tube, we have to deal with inosite. This can be conveniently expressed by the following formula :—

Bacillus paratyphosus B Schottmüller, var. M +
Bacillus paratyphosus A Schottmüller ... O } = Inosite.

If the result of the test is :—

Bacillus paratyphosus B Schottmüller, var. M O
Bacillus paratyphosus A Schottmüller ... O

it means that the substance is neither inosite nor any other substance fermentable by *Bacillus paratyphosus* B, var. M, or *Bacillus paratyphosus* A, hence it cannot be glucose, levulose, maltose, saccharose, &c.

If the result of the test is :—

Bacillus paratyphosus B Schottmüller, var. M +
Bacillus paratyphosus A Schottmüller ... +

exhaust the urine with *Bacillus paratyphosus* A, and then inoculate with *Bacillus paratyphosus* B, var. M, using strains having approximately the same fermentation power. If gas is produced, the in-

ference is that the urine contained inosite in addition to other fermentable substances, which can be determined by using our general method.

Summary.

The whole subject can be condensed into the following formulæ:—

Mycologic Formulæ.

Glucose.

Monilia balcanica Castellani ... + = Glucose.

Levulose.

Monilia krusei Castellani ... ... + }
Monilia balcanica Castellani ... O } = Levulose.

Maltose.

Monilia tropicalis Castellani ... +
Monilia macedoniensis (*Monilia macedoniensoides*) Castellani ... O } = Maltose.

Monilia metalondinensis Castellani +
Monilia macedoniensis Castellani or *Monilia macedoniensoides* ... O } = Maltose.

Monilia pinoyi Castellani ... +
Monilia krusei Castellani ... O } = Maltose.

Monilia pinoyi Castellani ... +
Monilia macedoniensis (*Monilia macedoniensoides*) Castellani ... O } = Maltose.

Monilia tropicalis Castellani ... +
Monilia rhoi Castellani ... ... O } = Maltose.

Monilia pinoyi Castellani ... +
Bacillus morgani Castellani and Chalmers ... ... O } = Maltose.

Monilia metalondinensis Castellani +
Bacillus morgani Castellani and Chalmers ... ... O } = Maltose.

Galactose.

Monilia metalondinensis Castellani +
Monilia pinoyi Castellani ... O } = Galactose.

Monilia metalondinensis Castellani +
Monilia krusei Castellani ... O = Galactose.
Monilia macedoniensis Castellani +

Monilia tropicalis Castellani ... +
Monilia bronchialis Castellani ... O } = Galactose.

Monilia tropicalis Castellani ... +
Monilia macedoniensis Castellani +
Monilia krusei Castellani ... O } = Galactose.
Bacillus paratyphosus B Schottmüller ... ... +

Bacillus morgani Castellani and Chalmers ... ... + } = Galactose.
Monilia krusei Castellani ... O

Saccharose.

Monilia tropicalis Castellani ... +
Monilia metalondinensis Castellani O } = Saccharose.

Monilia tropicalis Castellani ... +
Bacillus coli communis, sensu stricto (does not ferment saccharose) Escherich ... ... O } = Saccharose.

Monilia tropicalis Castellani ... +
Bacillus paratyphosus B Schottmüller ... ... O } = Saccharose.

Monilia macedoniensis Castellani +
Bacillus coli communis, sensu stricto Escherich ... ... O = Saccharose.
Bacillus coli communior ... ... +

Monilia macedoniensis Castellani +
Bacillus paratyphosus B Schottmüller ... ... O } = Saccharose.
Bacillus coli communior ... ... +

Bacillus coli communis, sensu stricto Escherich ... ... O } = Saccharose.
Bacillus neapolitanus Emmerich +

Bacillus coli communis, sensu stricto Escherich ... ... O } = Saccharose.
Bacillus asiaticus Castellani ... +

Inulin.

Monilia macedoniensis (*Monilia macedoniensoides*) Castellani ... + } = Inulin.
Monilia tropicalis Castellani ... O

Monilia macedoniensis (*Monilia macedoniensoides*) Castellani ... + } = Inulin.
Monilia rhoi Castellani ... ... O

Monilia macedoniensis (*Monilia macedoniensoides*) Castellani ... +
Bacillus coli communior Escherich; or *Bacillus pseudocoli* Castellani; or *Bacillus neapolitanus* Emmerich ... ... O } = Inulin.

Monilia macedoniensis (*Monilia macedoniensoides*) Castellani ... + } = Inulin.
Bacillus asiaticus Castellani ... O

Inositol.

Bacillus paratyphosus B (var. M) Schottmüller ... ... + } = Inositol (with great probability).
Bacillus paratyphosus A Schottmüller ... ... O

Glycerol.

Bacillus asiaticus Castellani ... +
Bacillus paratyphosus B (var. M) Schottmüller ... ... O } = Glycerol.
Bacillus columbensis (strain L) Castellani ... ... +

Chemicomycologic Formulæ.

Saccharose.

Fehling ... ... O } = Saccharose.
Monilia tropicalis Castellani ... +

Lactose.

Fehling ... ... +
Bacillus paratyphosus B Schottmüller ... ... O } = Lactose.
Bacillus coli communis Escherich +

Fehling ... ... +
Bacillus orleanensis ... ... +
Monilia macedoniensis ... ... O } = Lactose.
Bacillus coli communis or *communior* ... ... +

Pentose.

Fehling ... ... +
Monilia tropicalis Castellani ... O
Bacillus paratyphosus B Schottmüller ... ... + } = Pentose (generally arabinose).
Bacillus coli communis Escherich +

As is the case with every other biological method, the results must be considered to be relatively and not absolutely certain. It is essential to use only selected strains of the organisms mentioned, with constant characteristics and producing a large amount of gas.

Abridged Method.

The method we now use as a matter of routine is carried out using the following organisms:—

1. *Monilia krusei* Castellani, 1909.
2. *Monilia tropicalis* Castellani, 1909.
3. *Monilia metalondinensis* Castellani.
4. *Monilia macedoniensis* Castellani, 1917. (Var. *macedoniensoides*).
5. *Bacillus morgani* Castellani and Chalmers, 1918.
6. *Bacillus coli communis* Escherich, 1886, *sensu stricto* (does not ferment saccharose).
7. *Bacillus coli communior* Escherich-Durham, 1899 (var. *pseudo-coscoroba*).
8. *Bacillus paratyphosus* B Schottmüller, 1902.
9. *Bacillus columbensis* (strain L) Castellani, 1905.

With the abridged method the following carbohydrates may be easily detected and identified: maltose, galactose, glucose (or levulose) saccharose, lactose, pentose and inulin.

Maltose.

Monilia tropicalis	+	= Maltose
Monilia macedoniensis	O	

Galactose.

Monilia metalondinensis	+	= Galactose.
Monilia krusei	O	
Monilia macedoniensis	+	
Bacillus morgani	+	= Galactose.
Monilia krusei	O	
Monilia macedoniensis	+	= Galactose.
Monilia krusei	O	
Bacillus columbensis (L)	+	
Monilia macedoniensis	+	= Galactose.
Monilia krusei	O	
Bacillus paratyphosus B	+	

Saccharose.

Monilia tropicalis	+	= Saccharose.
Monilia metalondinensis	O	
Monilia tropicalis	+	= Saccharose.
Bacillus paratyphosus B	O	
Monilia tropicalis	+	= Saccharose.
Bacillus coli communis, sensu stricto (does not ferment saccharose)	O	
Monilia tropicalis	+	= Saccharose.
Bacillus columbensis	O	

Inulin.

Monilia macedoniensis (var. *macedoniensoides*)	+	= Inulin.
Monilia tropicalis	O	

Lactose.

Monilia tropicalis	O	= Lactose (with great probability)
Bacillus paratyphosus B Schottmüller	O	
Bacillus coli communis or *Bacillus coli communior*	+	

Glucose and Levulose.

Monilia krusei	+	= Glucose (or levulose).

Chemicomycologic Formulæ.

Saccharose.

Fehling	O	= Saccharose.
Monilia tropicalis	+	

Lactose.

Fehling	+	= Lactose.
Bacillus paratyphosus B	O	
Bacillus coli communis	+	
Fehling	+	= Lactose.
Bacillus paratyphosus B	O	
Bacillus coli communior	+	
Fehling	+	= Lactose.
Bacillus columbensis (L)	O	
Bacillus coli communior	+	

Pentose.

Fehling	+	= Pentose (generally arabinose).
Monilia tropicalis	O	
Bacillus paratyphosus B	+	
Bacillus coli communis or *Bacillus coli communior*	+	

Cultivation of the Monilias kept as Stock Cultures.—The organisms should be grown and kept at 22° C. or at the temperature of the room. Certain monilias, if kept too long in the incubator at 37° C. may lose some of their fermentative characteristics. The best medium is acid glucose agar. Transplant once a month, and from time to time make plates to be certain that the cultures are pure.[1]

Conclusions.

(1) The yeast method, as described in most textbooks of medicine and clinical methods, is not specific for glucose, notwithstanding the statements to that effect. Ordinary samples of baker's yeast, as a rule, will ferment levulose, maltose, galactose, saccharose, lactose and many other carbon compounds in addition to glucose. When a sample of urine is fermented by ordinary yeast we cannot come to the conclusion that the urine contained glucose, as it might have contained maltose, galactose, lactose or other sugars.

(2) For the identification of glucose and its detection in the urine, a germ should be used which ferments glucose only. Such an organism is *Monilia balcanica* Castellani. When *Monilia balcanica* for some reason is not obtainable, the next best organism is *Monilia krusei* Castellani, which ferments glucose and levulose only, and does not affect maltose, galactose, lactose or any other carbon compound. When a urine is fermented by *Monilia krusei*, it contains with certainty either glucose or levulose or both.

(3) For the identification of various sugars and other carbon compounds, apart from glucose, the mycologic method, first devised by one of us (A.C.) in 1904, in Ceylon, and which we worked out together at King's College Bacteriological Laboratories in London and published in 1917, may be used with advantage. This method seems to be especially useful in the identification of maltose and galactose.

[1] We shall be pleased to supply the necessary bacteria and fungi to workers interested in the subject. Requests for cultures should be sent to the Director, Tropical Department, The Ross Institute, Putney Heath, London.

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THE PREVENTION AND TREATMENT OF CHOLERA BY ESSENTIAL OILS.

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THE Asansol Mining Settlement, which includes the chief coal field of Bengal, is situated in the sub-division of Asansol, at the western end of the district of Burdwan, and lies on either side of the main line running from Calcutta to Delhi, approximately between miles 114 and 144. The settlement, which is about 420 square miles in area, includes 263 collieries and 490 villages, with a total population of 329,353, according to the census of 1924, to which should be added an estimated floating mining population of not less than 100,000. The labour employed in the mining settlement consists chiefly of Sánthâls and Kóls, aboriginal peoples essentially agriculturists by nature, who reside permanently on the land in the districts adjoining the mining settlement but migrate into the settlement in search of work in the coal mines when supplies for any reason run short in their permanent homes, the average duration of their sojourn in the settlement not as a rule exceeding three months on any one occasion. A certain number of these people have, however, become domiciled in the mining settlement on land belonging to some of the larger collieries, and a proportion of mining labour is also drawn from an aboriginal tribe called Bowries indigenous to the mining settlement and permanently resident in the villages within it.

Owing to the fact that the mining settlement lies within the so-called endemic area of cholera in Bengal and to the migratory nature of the labour employed in the coal mines, epidemics of cholera were formerly so frequent and disastrous in this coalfield that at the request of the mining industry the Government of Bengal in 1912 passed the Bengal Mining Settlements Act "to prevent the outbreak and spread of dangerous epidemic disease" in the coalfields of Bengal, the Asansol Mines Board of Health being constituted in 1915 to carry out the provisions of this Act within the area notified as the Asansol Mining Settlement, of which the writer has been the medical officer of health since its inception. The "dangerous epidemic" diseases specifically referred to in the Act are cholera, small-pox and plague; plague, however, is unknown in this part of Bengal in epidemic form. For the prevention and suppression of small-pox in the settlement reliance is successfully placed on the vaccination during the cold weather months of all children born in the settlement during the preceding year and in the revaccination of all contacts when any outbreak of small-pox occurs. The problem of the prevention and suppression of cholera is a more difficult one, since the settlement is constantly exposed to the risk of the introduction of this disease by immigrant labour from without as well as to its dissemination from within. The dissemination of the disease within the settlement is chiefly due to the fact that throughout Bengal the water supply of the people is mainly derived from artificial ponds known as "tanks," the water of which is used indiscriminately by the inhabitants both for washing after defæcation and for drinking. Wells exist in great numbers in the mining settlement, but no uneducated native of the country ever voluntarily drinks well-water until all the ponds or "tanks" in the neighbourhood have become dry. Owing to these circumstances, when once cholera has broken out, it is extremely difficult to check its spread. From investigations at present being carried out by the writer in conjunction with Captain Maitra, I.M.S., of the Calcutta School of Tropical Medicine and Hygiene, it is extremely likely that the endemicity of cholera in Bengal is closely connected with the universality of ground "tanks" as sources of drinking water supply, associated with the insanitary habits and customs of the people and the favourable climatic conditions which enable the comma vibrio to survive in "tanks" throughout the year. In the "Regulations for the Prevention and Treatment of Cholera in the Asansol Mining Settlement" cholera is defined as "any sickness accompanied by vomiting and diarrhœa," and it may be here remarked that continued investigations in the Laboratory of the Mines Board of Health have demonstrated that this definition obtains bacteriological support in over 95 per cent. of cases.

When any case of cholera occurs on a colliery the manager of the colliery is by law required to send immediate notice of the fact by special messenger to the nearest circle-office of the board, which in no instance is situated at a greater distance than five miles away. Similarly, when any case of cholera occurs in a village the relatives of the patient are required by law to give immediate notice of the fact to the chowkidar or village-watchman, who at once notifies the nearest official of the Mines Board of Health. To induce promptitude in the latter case a reward of one rupee (one shilling and sixpence) is paid to the chowkidar for every such notification. The amount of money actually required for this purpose yearly is, however, very small, as when once a single case of cholera has been notified by

a chowkidar the staff of the Mines Board of Health keep in constant touch with the infected village until the epidemic is suppressed. On receiving information of a case of cholera in a village the board's "sanitary assistant" at once proceeds on his bicycle to verify the case and take all necessary steps for the prevention of the spread of the disease. These consist in the sterilization of the dejecta of the patient with some coal-tar disinfectant such as izal, and in the disinfection with chloride of lime of the neighbouring "tank," which, in almost every instance, has been polluted with the patient's excreta, either directly by the patient himself or indirectly by the patient's relatives. A solution of coal tar disinfectant is also left in the infected house in an earthenware vessel for the disinfection of the hands before eating of those actually engaged in nursing the patient. Experience over many years has proved that such measures are usually sufficient to check the extension of the disease in epidemic form, but that they are insufficient to check its spread within the infected house. This is as a rule due to negligence on the part of those attending on patients in not disinfecting or even washing their hands before eating, and also to the wholesale contamination of domestic utensils, both by the patient's attendants and by flies.

On collieries all preventive measures are carried out by the colliery medical staffs under the supervision of the circle staff of the Mines Board of Health.

With regard to treatment, cases of cholera occurring on collieries are treated by the colliery doctor babus, and by far the greater proportion of cases occurring in the villages of the settlement also receive treatment for payment by the same agency. A certain proportion of the cases, however, formerly, either through poverty or from remoteness from medical aid, received no treatment, and as the mortality rate in such untreated cases was found year after year to be in the neighbourhood of 90 per cent., it seemed to the writer that it was the duty of the Mines Board of Health on humanitarian grounds to undertake the treatment of all such cases.

The selection of a remedy then presented itself for solution, the remedy to be adopted having to fulfil certain conditions, viz., it had to be cheap, speedy and certain in action, and non-poisonous, since it was intended to be administered by the subordinate outdoor staff of the board, who possess no medical knowledge or qualifications.

For the treatment of cholera at the time the only recognized medical remedies were chlorodyne, kaolin and potassium permanganate pills. Of these chlorodyne was at once rejected as being a scheduled poison, kaoline after trial was rejected as being unpopular and unsuitable for field work on account of its bulk, though the results obtained in cases which persevered with the treatment were very satisfactory, showing a mortality rate of only 25 per cent.; potassium permanganate pills on trial were rejected as valueless.

Some years prior to becoming the health officer of the Mines Board the writer's attention was drawn to a formula formerly widely used throughout India and known variously as "mist. pro-diarrhœa" or "cholera drops," which, for some reason or other, had fallen into desuetude, probably owing partly to the fondness of the profession for new remedies and partly to failure to administer the mixture in effective doses. The actual formula was a somewhat complicated one, but was in reality a solution of the oils of aniseed, juniper and cajaput in alcohol and ether, acidified with one per cent. sulphuric acid. This solution, so far as the writer was able to ascertain, had commonly been administered in *drops*, the number and frequency of administration of which being left to the discretion of each individual prescriber. On theoretical grounds the formula seemed to the writer to be likely to prove an excellent one if administered rapidly in sufficient doses, the alcohol and ether forming jointly a highly diffusible stimulant, while the essential oils are both germicidal and carminative, oil of juniper being at the same time a potent diuretic.

The writer, therefore, advised the Mines Board to adopt the formula in the form given below:—

		Minims.
℞.	Ol. anisi (or cloves)	5
	Ol. cajaput	5
	Ol. juniper	5
	Acid. sulph. aromat	15
	Spt. æther	30

Misce.—1 dram every half-hour or ½ dram every quarter hour in water until 1 ounce has been given and thereafter 1 dram every hour until complete recovery has taken place.

(The mixture can conveniently be made up in bulk by mixing 1 lb. of each of the oils named, with 3 lb. of acid. sulph. aromat. and 6 lb. of spt. æther, the oils being added last to ensure their ready solution.)

Oil of cloves was at first substituted for the oil of aniseed in the original formula on the assumption that it would be more highly germicidal and that better results would therefore be secured. Experience, meanwhile, in Madras and in the mining settlement has proved that oil of cloves possesses no marked superiority over oil of aniseed and that the latter produces a much less pungent and more palatable mixture; oil of aniseed has, therefore, now been permanently adopted in place of oil of cloves.

On trial this mixture proved of the greatest value, as vomiting and purging were found to cease almost immediately after its administration, collapse being thus obviated in practically every instance. From the records of hundreds of cases treated with the mixture in the mining settlement during the past three years it can be confidently stated that if administered according to directions before collapse has set in the mixture is capable of curing 95 per cent. of cases, intravenous isotonic saline injections alone or combined with alkalies in the form of sodium bicarbonate, 160 gr. to the pint, as recommended by Sellands, being necessary in those cases only in which for any reason collapse ensues. Shortly after the introduction of the essential oils mixture an outbreak of cholera was reported from a village in the

settlement where the inhabitants of a whole line of huts had drunk the water of a cholera-infected tank, many persons being struck down with the disease simultaneously. These cases all accepted the offer of treatment by the board's staff with the essential oils mixture, and while the staff were carrying this treatment out several fresh cases were observed to develop.

These latter cases also were forthwith treated with the mixture and it was found that vomiting and purging thereupon immediately ceased, the disease apparently being aborted in every instance. On this being verified by the writer it seemed to him that if the mixture was able to abort the disease at its incipient stage it ought also to be able to prevent the onset of symptoms in those exposed to infection by contact, if administered in sufficient doses in due time. Accordingly, orders were issued to the staff that in future in all instances, whether the patient was being treated with the essential oils mixture by the board's outdoor staff or not, all contacts living in houses where cholera existed were to have the mixture administered to them at least once a day as a prophylactic, those actually engaged in nursing to receive the mixture both morning and evening. The results of this procedure have far exceeded all expectations, for amongst some thousands of house contacts in the mining settlement thus treated with the mixture as a prophylactic during the past three years less than 1 per cent. have subsequently developed the disease. In those cases, moreover, in which the disease actually develops, in spite of the generally effective prophylactic doses, it is observed that the symptoms are mild and readily respond to further treatment with the essential oils mixture. From investigations at present being carried out there is reason to believe that almost *absolute* protection for the individual can be obtained by administration of the mixture as a prophylactic three times a day. In the *Indian Medical Gazette* of April, 1925, p. 155, a suggestion was put forward by a writer that the good effects of the essential oils mixture, both in treatment and prophylaxis, were probably due to the aromatic sulphuric acid which it contains. Experiments since carried out in the mining settlement have shown that this is not the case, aromatic sulphuric acid being practically valueless as a prophylactic, though of considerable value in treatment if given in full doses with the same frequency as the essential oils mixture. As a treatment, aromatic sulphuric acid would appear to be of about the same value as the common "cholera mixture" containing opium in some form or other, the mortality rate from treatment with which in the mining settlement has been found in hundreds of cases over a long series of years to be consistently in the neighbourhood of 50 per cent., as compared with a mortality rate of 90 per cent. in untreated cases.

The great value of the essential oils mixture in cholera may be summed up as follows:—

(1) If administered as soon as vomiting and purging declare themselves it immediately aborts the disease and prevents the onset of collapse.

(2) It is a valuable and highly efficient prophylactic.

(3) Its administration can be entrusted to any intelligent layman.

(4) One person can attend to hundreds of cases if necessary at one and the same time.

(5) It is cheap, palatable and non-poisonous.

Abnormal Bacteria Flagella in Cultures (H. Noguchi, *Journal of the American Medical Association*, May 1, 1926).—These investigations show that besides the leptospira-like filaments, probably originating from red blood-corpuscles under certain conditions *in vitro*, other spiral elements exist which may be erroneously interpreted as spirochætes. These are the exaggerated detached flagella of certain bacteria, produced under cultural conditions. In cultural studies of micro-organisms the occurrence of these spiral elements must be borne in mind, particularly in connection with dark field illumination. Spirochætes belonging to the *Spironema* and *Treponema* groups also produce, under certain cultural conditions, exaggerated flagellar appendages. These terminal flagella are similar in appearance and structure to the axial spiral filaments of the same organisms, but are much finer. The axial filaments are covered with a layer of cytoplasm which can be removed by the action of bile. The motility of these organisms resides in the portion of the filament next the attachment of the flagellum at either end. The great resemblance which exists between the flagella of motile bacteria and the flagellar and axial spiral apparatus of certain spirochætes seems to indicate that the axial filaments are probably a modified apparatus of similar origin, especially adapted to the locomotion of spirochætes, and therefore supports the hypothesis of a close phylogenic relationship between bacteria and spirochætes.

Identity of Ohara's Disease and Tularæmia (F. Francis and D. Moore, *Journal of the American Medical Association*, May 1, 1926).—Ohara's description of the clinical and epidemiological characteristics of a disease observed in Fukushima city, Japan, agrees even in minor details with the picture of tularæmia. The following tests were made in Washington, D.C., by the United States Public Health Service: (1) Serums collected and forwarded by Ohara from cases which came under his observation were agglutinated and *Bacterium tularense* was isolated: (2) Reciprocal agglutination absorption tests failed to distinguish any difference between the Japanese culture and an American culture. The conclusion reached is that Ohara's disease occurring in Japan and tularæmia occurring in the United States are identical.

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GANGRENE IN MALARIA.

AMONGST the complications and sequelæ of the infectious diseases gangrene, usually occurring as a symmetrical gangrene of the extremities, constitutes one of the most rarely encountered phenomena, and one that is barely mentioned in the textbooks.

In 1904, however, Barraud collected and analysed a series of 103 cases of gangrene of the extremities following the various infectious diseases. He limited his investigations to cases occurring in young persons, thus eliminating cases of senile or pre-senile gangrene due to arterio-sclerosis in older subjects; he also excluded cases of spontaneous gangrene resulting from Raynaud's disease.

In this series of 103 cases the gangrene had resulted from typhoid fever in 44 cases, from typhus fever in 11, from measles in 6, from scarlet fever, pneumonia and acute articular rheumatism in 5 each, from influenza, diphtheria, erysipelas and malaria in 2 each, from pertussis, dysentery, relapsing fever, and cholera morbus in 1 each, and from various surgical conditions in 14. The small number contributed to this list by malaria indicates the variety of the occurrence of gangrene in malaria and it would appear that of all the complications and sequelæ of malaria gangrene constitutes one of the most rarely encountered.

Nevertheless, this condition had been recorded even before Laveran had announced the discovery of the pathogenic agent of malaria, for in 1869 Rey reported the first case of symmetrical gangrene in a man who had suffered from intermittent fever in Senegal and had had a relapse on his return to France. Laveran himself also described a case of gangrene of both lower extremities as a complication of malaria. Further cases were recorded, 1 by Osler in 1900, 2 from India by Hammond in 1913, and 2 by Paisseau and Lemaire in 1917.

In Osler's case the gangrene involved the feet, hands, buttocks and occiput, and the blood contained crescents and æstivo-autumnal organisms in unusually large numbers. In Hammond's cases the extremities were also affected, one case recovering, the other being fatal. In the case which recovered malignant tertian rings were abundantly present, but in the fatal case the type of malaria is not mentioned.

In Paisseau and Lemaire's 2 cases the gangrene was symmetrical and involved the lower extremities. Both were fatal, and both showed a severe infection with *Plasmodium falciparum*.

Slaughter (*Journal American Medical Association*, May 22, 1926) has recently reported a further case in which a young American seaman contracted malaria in San Domingo after being shipwrecked off Haiti. The infection was æstivo-autumnal malaria of the delirious pernicious type, with acute nephritis and hæmoglobinuria; and the gangrene was symmetrical in both feet, necessitating amputation of the right great toe at the metatarso-phalangeal articulation.

He responded well to intravenous medication with quinine, and three months after admission was discharged from hospital in good physical condition. The feet had completely recovered except for a tingling sensation on walking.

The differential diagnosis of this case, as worked

out by Slaughter, presents several points of interest.

The absence of pulsation in the dorsalis pedis artery eliminated a symmetrical gangrene of the Raynaud type due to vaso-constriction. The absence of pulsation pointed to embolism or thrombosis, and thrombosis appeared to be the most probable causative factor. As there was no evidence of heart disease, the gangrene was not due to embolism associated with heart disease. Trauma, heat, cold, chemicals and drugs were all readily excluded as the cause of the gangrene.

Syphilis was eliminated as the cause of the gangrene, as there was neither history nor evidence of syphilis, and the Wassermann reaction was repeatedly negative.

Diabetic gangrene was eliminated on laboratory findings.

Senile gangrene was eliminated by the patient's age, by the physical examination and by the symmetry of the lesions.

Thrombo-angiitis obliterans was eliminated by the absence of redness, intermittent claudication and migrating phlebitis, and by the history and course of the case.

The polyneuritis of beriberi, erythromelalgia and syringomyelia were all considered and eliminated as the cause of the gangrene.

With regard to the manner in which the gangrene is brought about by malarial infection it is agreed that gangrene is the result of lack of nourishment of the part affected, due to arterial obstruction, and is therefore usually encountered as the dry type of gangrene.

The arterial obstruction may result from three factors, namely, constriction of the arterioles, due to spasm or vaso-constriction, embolism or thrombosis. The trend of present-day opinion appears to favour the view that thrombosis is the usual causative factor.

It is further to be noted that in the recorded cases in which the type of malaria is mentioned, it is always the malignant tertian type of malaria in which gangrene of the extremities occurs, that the infection is of a very severe character, having a high mortality, and that the most favourable results are to be expected from the energetic application of quinine by intravenous medication.

F. E. T.

Annotations.

Angioneurotic Œdema. Report of Case with Necropsy Findings. (I. M. Wason, *Journal of the American Medical Association*, May 1, 1926).—Watson describes a condition of extreme œdema of the respiratory tract, with mild and variable type of cellular reaction. In some sections of the lungs the character of the response suggests an early inflammation. In other sections of the lungs and the pharynx the picture is not unlike that sometimes seen following protein sensitization; namely, a predominance of mononuclear cells.

Use of Iodized Oil in Diagnosis and Treatment of Bronchial Affections (S. Pritchard, B. White and J. K. M. Gordon, *Journal of the American Medical Association*, May 1, 1926).—By the injections of iodized oil into the bronchial tree, small bronchiectatic dilatations in and around the roots of the lungs and cylindric fusiform enlargements of the descending branches may be revealed in many cases of chronic cough, which a previous exhaustive examination of the chest failed to show. The entire bronchial tree cannot be visualized at one injection. Small sections should be injected at intervals until any abnormality is discovered or the entire field is studied. The nose and throat should be studied in all cases. Bronchiectatic cavities occur as the result of chronic upper respiratory infections and may continue to cause cough after the tonsils are removed or the sinuses drained. In the majority of cases, the supraglottic method of injecting the lung-roots and descending branches of the bronchial tree takes less time, less anæsthesia, is less worry for the patients and gives results quite as satisfactory as other methods. It is not necessary to use extensive local anæsthesia in the majority of cases. In more than 600 bronchial injections of iodized oil, no ill-effects occurred. The technique is not difficult. It requires no special training. Negative results of an injection are no diagnostic proof that bronchiectatic dilatations do not exist. The therapeutic use of iodine is not new, but this compound of iodized oil is a new combination, and, as a result of the slow liberation of the iodine in the bronchial tree, acts as an ideal treatment in chronic affections of the lower respiratory tract. In acute affections or pulmonary tuberculosis, iodized oil for either diagnostic or therapeutic purposes should not be used.

Exophthalmic Goitre. A Follow-up Study of Cases Treated with the Roentgen-Ray (B. J. Sanger, *Archives of Internal Medicine*, May 15, 1926).—Fifty patients with exophthalmic goitre were carefully studied under Roentgen-ray therapy. They were followed at frequent intervals during their course of treatment and subsequent to their recovery with basal metabolism and clinical observations. Some have been followed for as long as five years. The great majority, 82 per cent., became well and remained so. Of the remaining 18 per cent., 6 per cent. were improved, 8 per cent. were operated on, and 4 per cent. were lost to the follow-up clinic during last year, so that the ultimate result is doubtful. On the whole, the Roentgen-ray offers a safe and satisfactory therapeutic procedure with a high percentage of cures, in cases of exophthalmic goitre.

Iodized Salt in the Prevention of Goitre. Is it a Safe Measure for General Use? (C. L. Hartsock, *Journal of the American Medical Association*,

May 1, 1926).—Iodine administered in small quantities, periodically, to children under the age of puberty is a very efficient preventive of simple goitre. Its use should be begun early and continued until puberty. At the age of puberty before iodine is prescribed a careful examination of the thyroid gland should be made by a physician to determine whether or not fœtal adenomas are present; if iodine is used at all, it should be used with great caution, and in all cases the patient should be warned to discontinue the iodine should symptoms of hyperthyroidism occur. The continuous use of iodine over a long period of time should never be prescribed for adults, and when its periodic use is prescribed, frequent observations of the pulse and weight should be made. Under no circumstances should iodine be administered to adults with fœtal adenomas, either with or without symptoms of hyperthyroidism, except for a short period preceding operation. In the occasional case in which there is temporary improvement, the patient will be lulled to false security and eventually a marked overactivity of the gland will result if the use of iodine is continued. In the case of an adult patient who has a simple, large colloid goitre or a large colloid adenomatous goitre without fœtal adenoma, iodine sometimes has remarkably beneficial results and may be tried, but only with extreme caution, as it is this type of goitre that may become suddenly and overwhelmingly active, so that what appears one week to be a wonderful clinical result in every way may be a fulminating case of hyperthyroidism the next week, with a basal metabolic rate of plus 75 to 100, marked asthenia and a loss of from 5 lb. to 10 lb. (2 to 4 kg.) in one week. If compound solution of iodine or iodine is administered in cases of exophthalmic goitre in which operation is not to be done, it should be discontinued or very greatly reduced when the basal metabolic rate is lowered and clinical symptoms improve. Continued use of the iodine will often again overactivate the thyroid gland. Iodine should not be administered to a patient who has recovered after thyroidectomy unless hyperthyroidism exists, and even in these cases thyroid extract is usually more satisfactory. Iodine is most efficiently administered and controlled in the form of chocolate tablets containing 10 mg. of organic iodine, or compound solution of iodine (Lugol's solution) when this is given under medical supervision. Periodic administration of iodine is always preferable. Iodine may be administered in small doses to the pregnant woman for the prevention of goitre in the fœtus. It is supposed to prevent fœtal adenoma as well as colloid goitre. The amount of iodine required for this purpose is exceedingly small, and the best form in which to administer it is the chocolate tablet. Extreme caution must be used as the thyroid gland is in a very unstable condition during pregnancy and iodine may cause it to become hyperactive. When overactivity of a thyroid gland has been induced by iodine, it usually does not subside when the iodine is discontinued, just as hyperactivity of the gland due to any other cause may not subside with the withdrawal of the exciting agent. In either case an operation is usually required. The author states that this article is in no way a criticism of the principle of goitre prevention as a whole, for in this field lie untold possibilities for the future. The criticism is directed solely against the fallacious ideas regarding the use of iodine which have gained such wide publicity. Community administration of iodine disregards physiologic facts regarding the effect of iodine on the thyroid gland. The use of iodized salt, in particular, should be discontinued or limited absolutely to periodic table use by children under the age of puberty.

Urinary Proteins. Crystalline Proteins of Nephritis (W. H. Walker, W. A. Thomas and L. Hecktoen, *Journal of the American Medical Association*, May 1, 1926).—In ten cases of nephritis, proteins were obtained in the form of globular crystals from the urine. In one instance the protein appeared as needle-like crystals. Precipitin tests indicate that the protein crystals consist of compounds of serum albumin, euglobulin and pseudoglobulin.

The Mode of Action of Bayer "205" on Trypanosomes (I. J. Kligler and I. Weitzman, *Annals of Tropical Medicine and Parasitology*, July 26, 1925).—The experiments described have brought about two interesting facts. First that contrary to the general belief that Bayer 205 exerts little trypanocidal action *in vitro*, it appears that the drug has a marked effect on the cell so that a dilution of 1:1,600 is sufficient to destroy the virulence of the organisms. Second, that in rabbits at least, the therapeutic, abortive and prophylactic doses are similar. A dose of 0·1 grm. per kilo cured all animals; 0·05 grm. per kilo gave about 80 per cent. cures, while 0·005 grm. per kilo was not effective. The therapeutic property of Bayer 205 is due to a direct injury to the trypanosomes which renders them avirulent for the host and thus readily destroyed and eliminated.

A Case of Sickle-cell Anæmia in the Sudan (R. G. Archibald, *Transactions of the Royal Society of Tropical Medicine and Hygiene*, January 21, 1926).—A case of anæmia associated with marked debility, pyrexia, slight jaundice, œdema of the feet, enlargement of the liver and lymphatic glands, occurring in a native of the Sudan is described. Blood examination showed a diminution of the red blood-cells, leucocytosis, low hæmoglobin percentage, colour index of 0·9, erythroblasts and phagocytosis of red blood-cells. The most striking feature in fresh and stained preparations of the blood was the large number of elongated and sickle-shaped erythrocytes, averaging nearly 50 per cent. Hanging-drop

preparations of fresh blood suitably sealed and kept at room temperature (31° C) showed, after twenty-four hours, nearly 100 per cent. of sickle cells. The sickling is apparently due to some inherent property of the cell, independent of any substance in the serum. The blood picture is identical with that of sickle-cell anæmia, differing only in the absence of any skin lesion. The ætiology is obscure, cultural tests and animal inoculations yielding negative results.

A New Method of Diagnosis and of Vaccine Treatment in Leprosy (J. Hasson, *Transactions of the Royal Society of Tropical Medicine and Hygiene*, January 21, 1926).—The author claims to have proved the success of vaccine treatment in leprosy and remarks that in future, if anti-leprosy therapy is to succeed, the physician must resort to vaccine therapy and leave the other preparations, the so-called "specifics" in leprosy for the treatment of consolidation. Chaulmoogra, in its various forms, is to be rejected in the treatment of "attack" conditions, since it cannot be relied upon to give the desired results. The author will be glad to supply small quantities of vaccine to anyone desiring to test the claims made.

A Contribution to the Study of Onchocerca volvulus Leuckart, with some Observations on its Prevalence in Nigeria (N. A. Dyce Sharp, *Transactions of the Royal Society of Tropical Medicine and Hygiene*, January 21, 1926).—Onchocerciasis is not confined to persons exhibiting obvious tumours or skin affections, and is, moreover, far more common than has hitherto been described. Parsons, of Nigeria, anticipated this in 1911. The embryosis is more often found in the skin than in definite tumours. The larvæ of *O. volvulus* occur with great frequency in hydrocele fluid in Nigeria, and, while possibly innocuous, they may well stand in some causal relationship to this condition as well as to elephantiasis. *Agamofilaria streptocerca* Macfie and Corson, 1922, is not found at Kaduna among natives drawn from all over the country. This organism, moreover, is easily distinguishable from the embryos of *O. volvulus*, with which on the Gold Coast it is so often associated.

Treatment of Leprosy by a Vaccine of Autolysed Tubercle Bacilli (R. Row, *Transactions of the Royal Society of Tropical Medicine and Hygiene*, January 21, 1926).—Since sera from leprous patients show a very strong antibody content against the antigens contained in the author's autolysed tubercle vaccine, an attempt was made to extend the application of this vaccine to nerve and nodular leprosy. The following results have been obtained by a prolonged course of weekly injections of 0·025 mg. of the autolysed tubercle material lasting five months or more. Thickened nerve trunks became smaller and assumed normal size. Anæsthetic areas lost their anæsthesia, became glossy at first and resumed practically normal conditions with the growth of hair where this was lost. The margins of these areas became flush with the surrounding skin and beyond a slight discoloration nothing abnormal can now be noticed in them. Trophic and perforating ulcers heal rapidly, but in some cases the vulnerability of the parts remains, even after healing of the ulcer. Atrophied muscles, if recovering at all, are very slow in doing so; they remain atrophied when the disease has destroyed muscular tissue. In disfigured conditions of the face the vaccine seems to be of benefit in restoring the natural contour of the features, the thickening of the parts gradually disappearing. In defined nodular lesions the prolonged course of the vaccine leads to their complete absorption and to the return of the features to normal. In all cases this autolysed tubercle vaccine has been administered subcutaneously every week without exciting any local, focal, or general reaction. The first three or four injections usually do not produce any change in the lesions, but may sometimes make them appear a little angry.

Medical News

At the Annual Meeting of the Royal Society of Tropical Medicine and Hygiene, held at 11, Chandos Street, London, on Thursday, June 17, the Manson Medal was presented to Senator Professor Ettore Marchiafava, of Rome, in recognition of the part he took in the elucidation of the life-history of the parasites of human malaria.

The foundation stone of the new house of the London School of Hygiene and Tropical Medicine, the gift of the Rockefeller Foundation, was laid at 3.30 p.m. on Wednesday, July 7, by Mr. Neville Chamberlain, Minister of Health.

The Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S.W.15, will be opened by H.R.H. The Prince of Wales to-day, Thursday, July 15.

THE UNIVERSITY OF LIVERPOOL.

EXAMINATION LIST.

June, 1926.

Faculty of Medicine—Diploma in Tropical Hygiene.

W. J. Aitken, M.B., Ch.B.; N. Bligh-Peacock, M.B., Ch.B.; T. Cullen, M.B., Ch.B.; E. G. A. Don, M.B., Ch.B.; H. P. Fowler, M.B., Ch.B.; D. Lennox, M.D.; A. G. Mackay, M.B., Ch.B.; F. Oppenheimer, M.B., Ch.B., I.M.S.; S. A. Talib, M.B., B.S.; N. S. Turnbull, M.B., Ch.B.

Original Communication.

OBSERVATIONS ON THE IMPORTANCE OF SYMBIOSIS OR CLOSE ASSOCIATION OF DIFFERENT SPECIES OF ORGANISMS IN THE PRODUCTION OF CERTAIN BIOCHEMICAL PHENOMENA AND IN THE CAUSATION OF CERTAIN DISEASES AND CERTAIN SYMPTOMS OF DISEASE.

By Aldo Castellani, C.M.G., M.D., F.R.C.P.

The subject of symbiosis has, so far, attracted little attention from medical men and bacteriologists. I use the term symbiosis *sensu lato* to indicate the living together of two organisms in close association, their close association not being detrimental to either of them; symbiosis *sensu stricto* means that the association is not only not detrimental, but mutually beneficial. Botanists, on the other hand, have been interested in symbiosis for many years. They discovered, for instance, that a large group of plants represents a symbiosis of two different vegetal organisms; they also found that symbiosis plays an important rôle in the nutrition process of numerous plants and in the germination of certain seeds.

Symbiosis between two vegetal organisms. Composite plants.—The best known example is furnished by the lichens. A lichen is a composite plant consisting of a green alga and a fungus which may be grown separately with difficulty. All of us have observed the green dust which often occurs on lichens. This powdery dust consists of young associations called soredia of algal cells and fungal hyphæ. Another well-known symbiotic plant is the ginger-beer plant, the lumps of which are composed of a yeast (*Saccharomyces pyriformis*) and a bacterium (*Bacterium vermiforme*).

Symbiosis between a vegetal organism and an animal organism.—Symbiosis may also occur between plant and animal. For instance, in the marine worm convoluta an alga is always present, and in the larvæ of certain aphids, coccids, &c., yeasts occur as more or less definite structures.

Importance of symbiosis in the nutrition process of certain plants.—Reissek, in 1847, came to the conclusion that fungi were normally present within the cortical cells of the roots of various flowering plants, being best developed in the underground roots of orchids. Soon after, another type of association was noted, especially in forest trees. Here the fungus mycelium forms a sort of mantle around the root, in contrast to being within the cells of the cortex. This association is very common in *Castanea* and *Corylus*. The rootlets so infected generally take a characteristic coralloid appearance. Frank, in 1885, coined the term " mycorrhiza " to denote fungi (including bacteria) in or around the roots of plants. He used the term " endotrophic mycorrhiza " for those forms in which the fungus occurred within the tissues of the host, and the term " ectotrophic mycorrhiza " when the fungal mycelium surrounded the rootlets as a sheath.

The antiquity of such associations is seen in the fact that they occur in fossil plants such as *Rhynia*, *Hornea*, and *Asteroxylon* from the Lower (or Middle) Devonian. Weiss, in 1906, recorded mycorrhiza in fossil roots from the lower coal measures, for which he suggested the name " mycorrhizonium."

A well-known instance of symbiosis is represented by the nodules found in the roots of many leguminous plants. For many years it was noted that roots of leguminous plants such as peas and clover presented a large number of nodules or tubercles which were for a long time considered to be normal morphological features of such plants. Later it was



Fig. 1.

found that these nodules are formed by the presence of a bacillus (*B. radicola*). This bacillus is apparently always present in the soil; the bacillus enters through a root-hair, it reaches the interior of the cortex and begins multiplying there, producing the nodular outgrowths. The organism feeds and grows principally on the carbohydrates (sugars, &c.) supplied by the host plant, these having been produced as the result of the photosynthetic activity of plant leaves. The bacillus is therefore supplied by the plant with carbohydrate food, but the bacillus in return supplies the plant with the nitrogenous compounds necessary for the production of protoplasm, by utilizing the *free nitrogen* of the air circulating in the soil.

Most plants have to take their nitrogen in a combined form, as ammonia salts, nitrates, &c., as nitrogen is a very inert element and difficult to force into combination with others. *B. radicola* is one of the very few organisms which can perform this really stupendous work, provided that it is supplied with the means of obtaining the energy required for

the process in the form of appropriate carbohydrate nutrition. There cannot be any doubt about the facts, for the bacillus will do the same thing when cultivated outside the plant under strict experimental conditions.

After the bacilli have thriven for a while, mainly at the expense of the food supplied by the root in which they are living and multiplying, many of the individuals become weaker and undergo a sort of degeneration, whilst a few pass into a resting stage, in which they become highly resistent to adverse conditions of life. The leguminous plant, which hitherto has been giving out carbohydrate food to the bacillus, now begins to receive: it receives from the degenerated mass of bacilli the stores of nitrogenous matter they have accumulated, and this is a very good return for the sugars which it had previously expended. The comparatively few surviving bacilli serve to infect the soil—as the roots gradually rot—and then they are enabled to attack the roots of new leguminous plants.

Higher Plants.—The phenomena of symbiosis between root and fungi occur also in many plants higher than the leguminous, for instance in forest trees. In these trees the fungus mycelium forms a sort of mantle round the root, in contrast to being inside the cells of the cortex. The association is very common in *Castanea* and *Corylus*, the rootlets so infected generally taking a characteristic coralloid appearance.

Importance of Symbiosis in the Phenomena of Reproduction. Germination of Seeds.—Noel Bernard, in 1902, proved experimentally that certain seeds, as the seeds of orchids, can germinate only in the presence of appropriate fungi. If the seedling is not infected with the appropriate fungus, generally the same fungus which infects the roots of the adult parent plant, as a rule germination will not take place, or it will be slow and imperfect. Burgeff came to the same conclusion, viz., that orchid seeds germinate without difficulty on having the appropriate fungus supplied to them. It is interesting to note that before this was scientifically known, orchid growers had found that to make orchid seeds grow it was necessary to sow them in the soil containing the parent plant; the explanation is that the seed in this way got infected with the fungi necessary to induce germination, viz., the fungus which is found in the roots of orchids.

A few more details may be of interest: Orchid seeds taken from the capsule under sterile conditions and sown on ordinary substrata where no fungus is present do not as a rule develop. The only phenomenon observed in these conditions is that usually the seeds swell and after two or three months—viz., after the reserve food, which is oil, part of which becomes transformed into starch, has been exhausted—become green and soon after die, unless the fungus infestation takes place. At first it seems peculiar that the seeds should die after the production of chlorophyle; one would rather expect that autonomous growth by action of photo-synthesis should take place; as T. Ramsbottom aptly put it, it appears that the seedling forms chlorophyle as a sort of a last despairing effort.

Importance of Symbiosis in Fermentation Phenomena.—Two organisms neither of which alone produces gas-fermentation in certain carbohydrates may do so when living in symbiosis or artificially mixed together. This phenomenon is sometimes referred to as Castellani's phenomenon.

During the years 1904 and 1905, while in the East and in London on leave, I became interested in the study of baker's yeast and in fermentation caused by yeast. I made the following observations, mentioned at meetings of the Ceylon Branch of the British Medical Association.

(1) Baker's yeast, both in the East and in London, is not a pure culture of a single species of yeast. It is generally composed of two or more species of yeast plus one or two or several species of bacteria. The bacteria isolated from samples of yeast in the East and in London do not produce gas-fermentation in sugars—they produce simple acidity.

(2) Comparing the fermentation reactions of baker's yeast used *in toto* as obtained from the bakers, sowing the particles of the sample in the various sugars, with the fermentation reactions of the isolated pure cultures of the different species of saccharomyces and bacteria composing the sample, I found that the yeast *in toto* often ferments a larger number of carbohydrates than any one of the saccharomyces and bacteria composing the sample.

(3) By mixing artificially all the organisms isolated from the sample of yeast, in certain cases the same fermentation reactions are obtained as with the yeast *in toto*. There are apparent exceptions, as shown by the following example. From Orpington, a place in the country near London, I obtained in 1919 a sample of baker's yeast which gas-fermented a very large number of carbon compounds, including starch. I investigated the sample mycologically by plating on maltose and glucose agar, &c., and I isolated and grew in pure cultures all the organisms, saccharomyces and bacteria, apparently present in that sample. By mixing all the pure cultures, I obtained the same fermentation reactions as with the sample of yeast *in toto*, except that the mixture did not ferment starch. The experiment was repeated many times with the same result, until finally I had recourse to the following procedure: the surface of the glucose agar plates on which a minute particle of the yeast-cake had been plated out was washed with a little peptone water and the washing inoculated into starch. Fermentation took place, the inference being that probably some very minute colonies on the verge of invisibility had escaped my notice when investigating the plates and picking out all the colonies present; the thought came to me also that there might be an ultramicroscopic germ present.

(4) By mixing artificially a non-maltose fermenting saccharomyces (isolated from a sample of baker's yeast) with a bacillus isolated from the same sample, producing acidity in maltose and several other sugars, but never gas in any substance, I obtained fermentation of maltose with production of gas.

(5) In Ceylon by mixing two saccharomyces

isolated locally, neither of which alone produced gas or acidity in maltose, gas-fermentation of that sugar was obtained.

In recent years I have studied the same and similar phenomena, using mostly pathogenic bacteria: bacilli and cocci, also a pathogenic yeast. In the present paper I will limit myself to giving the results of experiments—a number of them already published—with the following organisms:—

(*a*) *Bacilli.*—*B. typhosus*, *B. dysenteriæ* Flexner, *B. morgani*, *B. proteus*, strain P., *B. coli communior*, *B. kandiensis*, *B. vermiculoides*.

(*b*) *Cocci.*—*Staphylococcus aureus*, two strains of *Streptococcus pyogenes*.

(*c*) *Yeast.*—*Cryptococcus graciloides*.

The strain of *B. typhosus* was isolated from a case of typhoid fever and shows all the typical serological reactions and biochemical characteristics of the typhoid bacillus; it is very highly agglutinated by typhoid serum; it does not produce gas in any carbohydrate; it produces acidity in glucose, levulose, maltose, galactose, mannitol, dextrin, and sorbite.

The strain of *B. morgani* was isolated from a stool; it is motile; it produces acidity and gas in glucose, levulose, and galactose, but neither acidity nor gas in any other sugar. In this paper I will refer to it as Strain S.

The strain of *B. dysenteriæ* Flexner is serologically and biochemically typical; it produces acidity in mannitol. It was obtained from the Lister Institute.

The strain of *B. proteus* was isolated from a case of enteritis; it is motile and liquefies gelatine and serum rapidly; it produces acidity and gas in glucose, levulose, galactose, saccharose, and glycerol; it produces neither acidity nor gas in lactose, dulcitol, mannitol, maltose, dextrin, adonite, inulin, sorbite, inosite, salicin, amygdalin, isodulcitol, or erythrite. As I have stated in other publications, the term *proteus* covers a group of closely allied bacilli and not one species only. The strain I have used is very similar to the variety which I called *paradiffluens* (see Castellani and Chalmers' "Manual of Tropical Medicine," 3rd edition, page 943). In this paper I will denote it as *B. proteus* (P).

B. kandiensis is an intestinal bacillus somewhat related to *B. typhosus*: it is motile and does not produce gas in any sugar; it produces acidity in glucose, levulose, galactose, mannitol, adonite, inosite, isodulcitol, erythrite; it does not clot milk; does not produce indol. There is a variety producing indol (*kandiensoides*).

The strain of *B. coli communior* produces gas in many sugars, including saccharose, but does not produce either acidity or gas in adonite.

The strain of *Staphylococcus aureus* was isolated at the Ross Institute, London.

The two strains of *Streptococcus pyogenes* were obtained from the Laboratories of Public Health, London.

B. vermiculoides and *Cryptococcus graciloides* were isolated from two cases of stomatitis cryptococco-bacillaris in Central America.

B. TYPHOSUS + B. MORGANI.

Action on Maltose.—*B. typhosus* alone produces acidity, never gas. *B. morgani* alone has no action whatever on maltose; it produces neither acidity nor gas. If a tube of maltose peptone water is inoculated, however, with *B. typhosus* and immediately after with *B. morgani* and placed in the incubator at 35° C. or 37° C. for 48 hours, not only will acidity be produced, but also a large amount of gas. The same result is obtained if the two bacilli are previously mixed in plain peptone water and the peptone water mixture inoculated into tubes of maltose. The same result is also obtained if *B. morgani* is added to *B. typhosus* twenty-four hours after inoculating with *B. typhosus;* if the interval is more than twenty-four hours, then the production of gas is not so constant.

When the two bacilli, *B. typhosus* and *B. morgani*, live naturally in close association, the same phenomenon takes place, as shown by the following observation, which I related in one of my previous papers: The stool of a suspected typhoid case was examined bacteriologically in London, using MacConkey's medium plates. An exceptionally large number of white colonies developed; fifteen were picked out and investigated further by replating, &c. Twelve of them consisted of two organisms—*B. typhosus* and *B. morgani:* three of *B. morgani* alone. The cultures derived from the colonies containing *B. morgani* only, had no action whatever on that sugar. Mixed cultures obtained artificially by inoculating agar tubes with both *B. typhosus* and *B. morgani* behave in the same manner—namely, when a loopful of the mixed growth is inoculated into a maltose peptone water tube, acid and gas are produced.

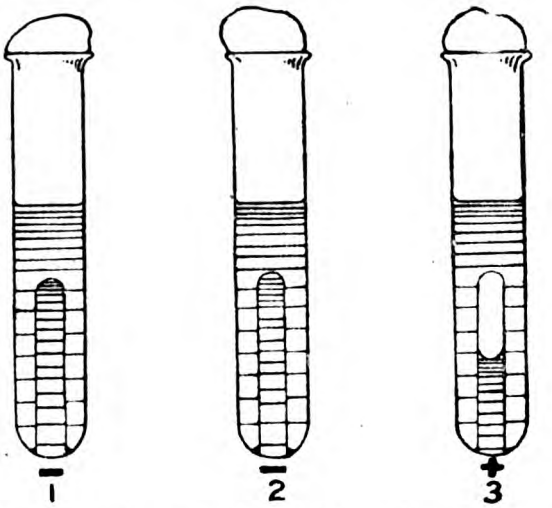


FIG. 2.—Action on maltose of *B. typhosus* alone, gas absent (1), *B. morgani* alone, gas absent (2), and *B. typhosus* + *B. morgani*, gas present (3).

Action on Mannitol.—As is well known, *B. typhosus* produces acidity only in mannitol, never gas; *B. morgani* has no action—no acidity or gas is

produced. The mixture *B. typhosus* + *B. morgani* produces acidity and gas.

Action on Sorbite.—*B. typhosus* alone produces acidity, never gas, in sorbite; *B. morgani* alone has no action whatever on sorbite; it produces neither acidity nor gas. The mixture *B. typhosus* + *B. morgani* produces acidity and gas.

Action on other Carbon Compounds apart from the above.—The reactions are seen at a glance in Table I, in which the fermentative characters are given of *B. typhosus* alone, *B. morgani* alone, and the mixture of *B. typhosus* + *B. morgani*.

TABLE I.

	Lactose	Saccharose	Glucose	Levulose	Maltose	Galactose	Mannitol	Sorbite
B. typhosus	O	O	A	A	A	A	A	A
B. morgani	O	O	AG	AG	O	AG	O	O
B. typhosus + *B. morgani*	O	O	AG	AG	AG	AG	AG	AG

O = negative, neither acid nor gas; A = acid; G = gas.

From the table it is seen that certain sugars and other carbon compounds, which when acted upon by *B. typhosus* alone undergo a simple acid fermentation, and when acted upon by *B. morgani* alone do not undergo any fermentation, neither acid nor gas being produced, they are capable of undergoing fermentation with production of gas when they are acted upon by the mixture of the two bacilli. In the carbon compounds in which *B. typhosus* alone produces no acidity and *B. morgani* alone neither acidity nor gas, their mixture produces neither acidity nor gas.

B. TYPHOSUS + B. PROTEUS.

The strain of *B. proteus* used (P), as already stated, has no action on maltose, mannitol, or sorbite; it produces neither acidity nor gas in these substances.

Action on Maltose.—*B. typhosus* alone produces acidity only, never gas; *B. proteus* (P) alone produces neither acidity nor gas; their mixture produces acidity and gas.

Action on Mannitol.—*B. typhosus* produces acidity, never gas, *B. proteus* (P) has no action on it; neither acidity nor gas is produced. Their mixture, however, produces acidity and gas.

TABLE II.

	Lactose	Saccharose	Glucose	Levulose	Maltose	Galactose	Mannitol	Sorbite
B. typhosus	O	O	A	A	A	A	A	A
B. proteus (P)	O	O	AG	AG	O	AG	O	O
B. typhosus + *B. proteus* (P)	O	O	AG	AG	AG	AG	AG	AG

O = negative, neither acid nor gas; A = acid; G = gas.

Action on Sorbite.—*B. typhosus* produces acidity only; *B. proteus* neither acidity nor gas; their mixture causes production of acidity and gas.

B. DYSENTERIÆ FLEXNER + B. MORGANI.

Action on Mannitol.—*B. dysenteriæ* Flexner produces acidity only, never gas. *B. morgani* has no action on it; neither acidity nor gas is produced. The mixture *B. dysenteriæ* + *B. morgani* produces acidity and gas.

Action on Maltose.—*B. dysenteriæ* Flexner produces only acidity, never gas; *B. morgani* produces neither acidity nor gas; their mixture produces acidity and gas.

B. DYSENTERIÆ FLEXNER + B. PROTEUS.

Action on Mannitol.—*B. dysenteriæ* Flexner produces acidity, never gas; *B. proteus* (P) produces neither acidity nor gas; their mixture produces acidity and gas.

Action on Maltose.—*B. dysenteriæ* Flexner produces only acidity, never gas; *B. proteus* (P) produces neither acidity nor gas; their mixture produces acidity and gas.

TABLE III.

	Lactose	Saccharose	Glucose	Levulose	Maltose	Galactose	Mannitol	Sorbite
B. dysenteriæ Flexner	O	O	A	A	A	A	A	O
B. morgani	O	O	AG	AG	O	AG	O	O
B. proteus (P)	O	O	AG	AG	O	AG	O	O
B. dysenteriæ Flexner + *B. morgani*	O	O	AG	AG	AG	AG	AG	O
B. dysenteriæ Flexner + *B. proteus* (P)	O	O	AG	AG	AG	AG	AG	O

O = negative, neither acid nor gas; A = acid; G = Gas.

B. TYPHOSUS + B. MORGANI + B. PROTEUS.

Action on Maltose, Mannitol and Sorbite.—*B. typhosus* alone produces acidity, no gas. *B. morgani* alone produces neither acidity nor gas. *B. proteus* (P) alone produces neither acidity nor gas. The mixture *B. morgani* + *B. proteus* (P) produces neither acidity nor gas. The mixture of the three germs produces acidity and gas.

B. COLI COMMUNIOR + B. KANDIENSIS (var. *kandiensoides*).

Action on Adonite.—*B. coli communior* produces neither acidity nor gas; *B. kandiensis*, acidity only, never gas. The mixture *B. coli communior* + *B. kandiensis* will produce acidity and gas, although slowly. The tubes must be kept at 37° for at least a week.

STAPHYLOCOCCUS AUREUS + B. MORGANI.

Action on Maltose.—*Staphylococcus aureus* alone (Ross Institute strain) produces acidity, no gas, in maltose; *B. morgani* alone produces neither acidity

nor gas. The mixture *Staphylococcus aureus* + *B. morgani* produces acidity and gas.

STAPHYLOCOCCUS AUREUS + B. PROTEUS.

Action on Maltose.—*Staphylococcus aureus* alone (Ross Institute strain) produces acidity, no gas, in maltose; *B. proteus* alone produces neither acidity nor gas. The mixture *Staphylococcus aureus* + *B. proteus* produces acidity and gas.

STREPTOCOCCUS PYOGENES + B. MORGANI.

Action on Maltose.—*Streptococcus pyogenes* (strain Public Health Laboratory, London) alone produces acidity, no gas; *B. morgani* produces neither acidity nor gas. The mixture *Streptococcus pyogenes* + *B. morgani* produces acidity and gas, but it may take eight or ten days at 37° C. before the gas appears.

STREPTOCOCCUS PYOGENES + B. PROTEUS

Action on Maltose.—*Streptococcus pyogenes* (strain Public Health Laboratory, London) alone produces acidity, no gas; *B. proteus* produces neither acidity nor gas. The mixture *Streptococcus pyogenes* + *B. proteus* produces acidity and gas, but it may take eight or ten days at 37° C. before the gas appears.

BACILLUS VERMICULOIDES + CRYPTOCOCCUS GRACILOIDES.

These two organisms live apparently in symbiosis and it took me more than a year to separate them. The symbiotic mixture produces gas, though very slowly, in glucose, levulose, and maltose. The cryptococcus alone does not produce either acid or gas in these sugars or any other carbohydrates; the bacillus alone produces acidity only.

or close association with *B. typhosus* it apparently loses its fermentative power on saccharose. The mixture *Monilia tropicalis* + *B. typhosus* produces no fermentation of saccharose peptone water.

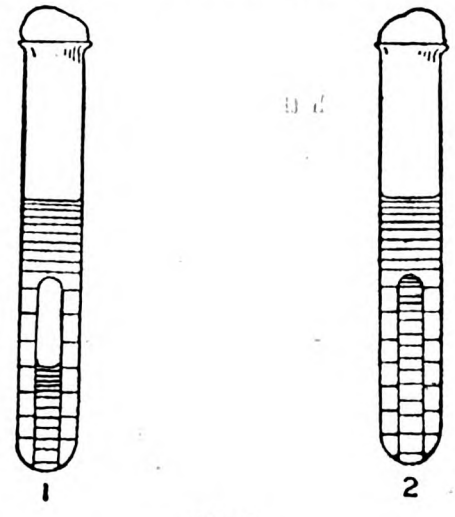


FIG. 3.

1. Saccharose peptone water inoculated with *Monilia tropicalis*. Gas present.

2. Saccharose peptone water inoculated with *Monilia tropicalis* + *Bacillus typhosus*. Gas absent.

Monilia krusei alone gas-ferments glucose rapidly and abundantly. *Bacillus talavensoides* alone does not gas-ferment glucose or any other sugar. When *M. krusei* is grown together with *B. talavensoides* no fermentation of glucose takes place. The mixture *M. krusei* + *B. talavensoides* does not produce gas fermentation in glucose peptone water.

TABLE IV.

	Lactose	Glucose	Levulose	Maltose	Galactose	Saccharose	Mannite	Dulcite	Salicin	Inosite	Dextrin	Inulin	Sorbite	Adonite	Arabinose	Raffinose	Isodulcite	Erythrite	Glycerine	Gelatine
Cryptococcus graciloides Castellani	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Bacillus vermiculoides Castellani	A	A	A	A	A	O	O	O	O	O	O	O	O or A *v.* S	O	O	O	O	O	O	O
Cryptococcus graciloides + *B. vermiculoides*	A	AG	AG	AG	A	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

A = acid; G = gas; O = absence of gas or coagulation; S = slight.

Symbiosis producing Inhibitory Phenomena.—The experiments I have described above show what might be called the activating effects of symbiosis. It may perhaps be of interest to quote experiments which show certain inhibitory effects of symbiosis. The following examples will suffice for the purpose of this paper.

Monilia tropicalis ferments saccharose with production of gas. *B. typhosus* does not ferment saccharose. When *Monilia tropicalis* lives in symbiosis

Monilia krusei produces gas in glucose; the mixture *Monilia krusei* + *B. talavensoides* does not.

Résumé and Conclusions.—Some years ago I found that the usual "baker's yeast," as obtainable in Ceylon and in England, is not a pure culture of yeast, but is generally composed of two or more species of *Saccharomyces* and one or two or several species of bacteria living in close association, and I made the observation that the whole yeast, as a rule, gas-fermented more carbohydrates than any of

the isolated germs did, either saccharomyces or bacteria. I found also that a bacillus (isolated from a sample of yeast) which produced acidity only, not gas, in maltose, would produce gas when I added to it a saccharomyces which was inactive on maltose and was isolated from the same sample.

In recent years I have used for my experiments mostly pathogenic bacteria and also a pathogenic yeast, *Cryptococcus graciloides*. Two organisms neither of which produces alone gas fermentation in certain carbohydrates may do so when mixed together. This phenomenon has been called by Fiallos "Castellani's fermentation phenomenon."

Simple acid fermentation of certain carbon compounds caused by micro-organisms which never produce gas may in a number of instances be transformed into fermentation with the production of gas by adding a micro-organism which, alone, is inert, viz., produces neither acidity nor gas on those particular carbon compounds. For example: *B. dysenteriæ* Flexner produces acidity, never gas, in maltose and mannitol; *B. morgani* produces neither acidity nor gas in these two carbohydrates; the mixture *B. dysenteriæ* Flexner + *B. morgani* produces, however, acidity and gas. The explanation of these phenomena, as pointed out recently by Schütze and Harde, lies probably in the fact that one of the organisms produces certain substances which are fermentable by the other organism.

In addition to activating phenomena symbiosis may give rise to inhibitory phenomena. For instance, *M. krusei* seems to lose its fermentative action on glucose when grown together with *B. talarensoides*.

The Importance of Close Association of two Organisms in the Ætiology of certain Diseases and in the Causation of certain Symptoms.—The whole trend of scientific medicine since Pasteur and Koch has been toward the mono-ætiology of disease—one disease, one specific germ. Few medical men ever give a thought to the possibility that certain diseases may be caused by the association of two organisms, neither of which alone is capable of producing the condition. Do diseases of this type really exist? One such disease has been known for years, viz., Plaut-Vincent's angina, caused by the association of two germs, a spirochæte and the fusiform bacillus, but objections have been brought forward against the condition being of true symbiotic origin. Certain authors, with whom I do not agree, consider the two so-called organisms to be different stages of the development of the same germ. Another objection of greater weight to the true symbiotic origin of the malady is that, according to certain observers, there are cases in which only the spirochæte or only *B. fusiformis* is present. A third objection is that in every case of so-called Plaut-Vincent's angina, a very large number of cocci and usually also various bacilli are present; it is not, therefore, merely a symbiosis between a spirochæte and the fusiform bacillus.

I venture to say that I am in a position to bring forward three examples of disease in which a symbiosis, or close association of two organisms, is apparently the true cause. These three diseases are of very little importance from a practical point of view, but I think they are interesting from a scientific standpoint. These conditions are:

(1) *Trichomycosis nigra.*
(2) *Trichomycosis rubra.*
(3) *Stomatitis Cryptococco-bacillaris.*

Trichomycosis nigra is a disease of the hair of the axillary and pubic regions, characterized by the presence on the shaft of the hair of small nodules of a jet-black colour. The microscopical examination of these nodules shows that they are composed of enormous numbers of bacillary bodies of a fungus (*Nocardia*), which I called *Nocardia tenuis*, and large numbers of a black pigment-producing coccal organism, *Micrococcus nigrescens* Castellani. We have here, therefore, an association between a fungus, *Nocardia* + a coccus. The fungus alone does not produce tinea nigra; it has no pigment.

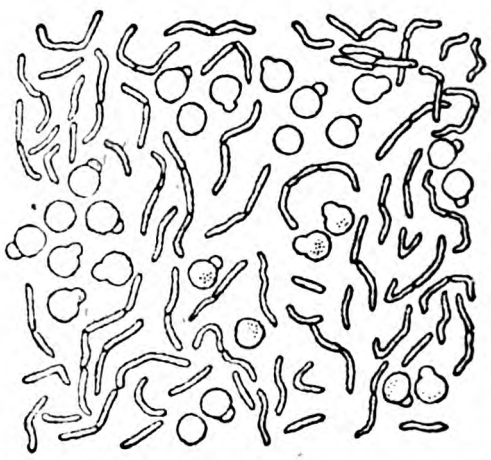


FIG. 5.—*Cryptococcus graciloides* and *B. vermiculoides* in symbiosis.

When the fungus is present alone the nodules are yellow (*Trichomycosis flava, leptothrix*). The micrococcus alone cannot reproduce the disease. I have never seen nodules consisting of the coccus alone; the coccus can be artificially grown; cultures smeared in various ways on the armpits and axillary hairs have never produced the nodular condition. Tinea nigra, therefore, may be considered to be caused by a symbiosis of two organisms, neither of which alone is capable of producing the typical condition.

DESCRIPTION OF NOCARDIA TENUIS.

Nocardia tenuis Castellani 1912. (Syn.: *Discomyces, Streptothrix, Cohnistreptothrix tenuis* Castellani 1912.)

The microscopical examination of the nodules in cleared specimens reveals the presence of enormous numbers of rod-like bodies—the bacilliform hyphæ of a Nocardia—which are Gram-positive, but not acid-fast. If the nodules are kept in alcohol or formalin for several months the fungus apparently loses partially or totally its property of being stainable by Gram's method. The bacillary

bodies vary in length from 2 to 8 microns and more; the average breadth is approximately 0·14 to 0·3 microns; they may be straight or slightly bent, very seldom if ever branching; they are fairly closely packed together, and are embedded in a cementing substance, apparently secreted by the fungus. This ground substance is fixed to the cortex of the hair, and a portion of it lies under the cuticle and some of the superficial layers of the cortex. In regard to cultivation, Chalmers and O'Farrell observed some slight growth in hanging drops of equal parts of human serum and normal saline. The fungus grew, showing branching forms and coccal forms. The branching was monopodial and the hyphæ were non-septate. Macfie, in one case, succeeded in cultivating the fungus on ascitic sugar agar, the colonies being very small and translucent.

Micrococcus (Nigrococcus) nigrescens, Castellani 1912.

This is a Gram-positive, rather large, non-motile coccus, which in certain media may take the appearance of coccobacillus. It produces a black pigment. Sugar media are more suitable for the growth of the organism than the ordinary agar.

Sabouraud Maltose Agar.—Colonies appear twenty-four to forty-eight hours after inoculation. They are roundish, at first white, but after a couple of days the centre of each colony turns black, and the pigmentation slowly spreads eccentrically. After a time the colonies may coalesce into a jet-black mass.

Glucose Agar.—Growth similar to Sabouraud, but slightly less abundant. The black pigmentation develops from the centre of each colony and slowly spreads towards the periphery.

Levulose Agar.—Identical to glucose.

Saccharine Agar.—The pigmentation is less pronounced, and does not spread to the whole of the growth.

Raffinose Agar.—Same as saccharine.

Lactose Agar.—Scanty pigmentation.

Alkaline Maltose Agar.—Black pigmentation well marked, though in many cases it does not extend to the whole of the growth.

Acid Maltose Agar.—Growth less abundant than on alkaline maltose. Black pigmentation well marked.

Mannite Agar.—As alkaline maltose.

Inulin.—As alkaline maltose, but pigmentation less pronounced.

Saccharose.—As inulin agar.

Glycerine Agar.—Abundant growth, the whole of which after a time becomes a jet-black colour.

Galactose.—As inulin.

Adonite.—As acid maltose.

Ordinary Agar.—Growth much less abundant than on most sugar agars, and black pigmentation less marked.

Serum.—Growth fairly abundant, but there is only a trace of pigmentation. The medium is not liquefied.

Gelatine.—No liquefaction. The growth on the surface shows after a time and some dark pigmentation, but the growth along the stab is white.

Milk.—No change.

Broth.—General turbidity. A thin pellicle is often present. The microscopical examination shows cocci arranged in pairs or irregularly. They do not appear to be capsulated.

Peptone Water.—Some growth at the bottom, while the rest of the tube is clear.

Sugar Broths.—No formation of acid or gas.

Indol.—Most strains produce a trace of indol.

Trichomycosis rubra is a somewhat similar condition to tinea nigra, but the nodules are of a bright red colour. The microscopical examination of these nodules shows that they are composed of a nocardial fungus, identical to that found in tinea nigra, plus a coccal organism present in large numbers and producing a red pigment. The fungus alone produces yellow nodules, never the red pigmentation; the coccus alone produces red pigment, but is not capable of producing the nodules. For the disease to develop, it is apparently necessary to have the two organisms closely associated, and tinea rubra can, therefore, be considered an example of disease of symbiotic origin.

Description of Micrococcus castellanii, Chalmers and O'Farrell 1913.

Syn. *Rhodococcus castellanii*, Chalmers and O'Farrell 1913.

This coccus, isolated in 1910 by me from the red variety in Ceylon, and later further investigated in the Sudan and named by Chalmers and O'Farrell, is more difficult to isolate and to grow than the coccus observed in the black type of the affection. It is interesting to note that as a rule it grows better and shows more pigment on ordinary agar than on sugar media. It is a round or oval coccus, measuring from about 0·3 to 0·7 micron in diameter. It is separated medianly by a clear central line into two half-moon-shaped segments, thus producing a diplococcal appearance. It is colourless and non-motile, but excretes an amorphous, non-granular lemon-chrome-coloured pigment. In old cultures another pigment of dark brownish-red colour appears (according to Ridgway's standards this colour is madder-brown), but its relationship to the earlier yellow pigment can easily be proved, as demonstrated by Chalmers and O'Farrell, by removing some of it and suspending it in a sufficiency of distilled water, when the fluid at once resembles a similar suspension of the yellow pigment. When, however, this is done in a very small quantity of water, a faint reddish tinge can be observed. The best medium for showing the striking yellow pigment is the potato, when in twenty-four hours the growth assumed that colour. The red pigment shows best in the ordinary agar slope, which, when old, exhibits the dark red pigment in the centre and the yellow pigment at the sides. The organism is easily stained by all the ordinary staining reagents, and is Gram-positive. However, even in preparations showing most of the cocci well coloured by Gram's methods a few cocci may be seen decolorized, and occasionally one may see cocci with one demilunar segment well stained, while the other is completely decolorized. The organism does not appear to have a capsule.

The coccus grows aerobically and also anaerobically. The optimum temperature appears to be 37° C.; it also grows at 20° C. on agar slopes, but not as abundantly as at 37° C., and the pigmentation is much less marked. Its rate of growth depends somewhat upon the medium; it grows quickest on potato, and next best on ordinary or glycerine agar. On solid media it gives rise to a yellow growth at first, but on most media, if kept long enough, some red coloration will subsequently be found. The best medium for the red coloration, as already stated, appears to be ordinary agar slope. With regard to the other agar media, it grows well on glucose and maltose agar. Like *M. nigrescens* it produces neither acid nor gas in glucose, levulose, galactose, arabinose, lactose, saccharose, raffinose, dextrin, inulin, amygdalin, erythrite, adonite, dulcite, isodulcite, mannite, sorbite, or inosite. It grows slowly on blood-serum, which does not liquefy, and well in broth and peptone water, in which it forms a general turbidity. Gelatine is not liquefied. It does not produce indol.

In agar stabs the growth is confined to the line of puncture and to the formation of a small yellow knob on the surface.

Classification of Micrococcus castellanii.—Chalmers and O'Farrell have thoroughly investigated this point: "The organism belongs to the family *Coccaceæ* (Zopf, emended Migula), and must be grouped with the genus *Micrococcus* (Hallier, 1866, emended Cohn, 1872). In this genus it certainly belongs to those forms which grow well on agar media and are Gram-positive, and in this division it belongs to the subdivision which produces colours.

"The cocci of this subdivision which possess red coloration are only three in number: *M. roseus* (Baum, 1885),

M. ruber (Trommsdorff, 1904), and *M. rubidus* (Hefferen). Under the term *M. roseus* (Baum, emend. Lehmann and Neumann) are gathered a large number of rose-coloured diplococci which are not known to be parasitic, and which produce growths on potato which are limited to the streaks. These growths are faint rose colour with an oily lustre and are often surrounded by a whitish glistening zone, thus giving rise to a very different appearance from that produced by *M. castellanii*. *M. ruber* (Trommsdorff, 1904), or, as it is sometimes named, *M. chromidrogenus ruber*, is characterized by the fact that it does not grow on potato; its colouring matter is not soluble in water, and when treated by sulphuric acid the red colour turns blue-green, while *M. castellanii* does grow on potato and its colouring matter is unaffected by 25 per cent. sulphuric acid; it appears to be closely related to *M. roseus* var. *carneus*, and to be non-parasitic."

Stomatitis cryptococco-bacillaris.

The appearance of the lesions is quite different from thrush. The patches, which are generally of large dimensions, are hardly raised at all, and are not cream-white; they have the appearance of a thin translucid whitish film covering parts of the oral mucosa, occasionally giving the impression of being patches of incipient diffused leucoplakia, but the microscopical examination of scrapings will clear the diagnosis. The first two cases of this stomatitis I observed in Central America; very recently I have seen a case of the same, or of a very similar condition, in England, but the investigation of this case has not yet been completed.

From these cases of stomatitis, clinically totally different from thrush, I have isolated a fungus and a bacillus which apparently live in symbiosis, both in the lesions and in the cultures. In glucose agar cultures a number of minute, almost streptococcus-like colonies will be seen. The microscopical examination of any of these colonies will show presence of both the delicate yeast-like fungus and the bacillus. For many months I did not succeed in separating the two organisms by plating and various other devices. I noticed that a high temperature (37° C.) increased the growth of the bacillus, while a low temperature was somewhat unfavourable to it. I noticed also that in MacConkey lactose agar tubes the fungus had a tendency to become more scanty. Making use of these two observations by repeatedly inoculating MacConkey lactose agar tubes and keeping some of them at 37° C., others at 15 to 22° C., I succeeded finally in separating the two organisms, of which I will here give a brief description.

(A) *Yeast-like Fungus* (*Cryptococcus graciloides*, Castellani 1925).—Very delicate yeast-like organism, Gram-positive, not acid-fast. Each cell is roundish, or more often oval, with frequently a flask-like shape. In preparations from the cultures the average maximum longitudinal diameter of most cells is 3 to 4·5 microns, and the maximum average transverse diameter is 2 to 3 microns.

Cultural and Biochemical Characters.

Glucose Agar.—Minute colonies somewhat streptococcus-like.

MacConkey Lactose Agar.—Minute colonies, but growth often more abundant than on glucose agar.

Gelatine and Serum.—Growth exceedingly scanty; neither of the media is liquefied.

Lead Agar.—No evident darkening of the medium.

Glucose and Other Sugar Peptone Waters.—Apparently no production of acidity or gas, but the organism grows extremely scantily in these media, and sometimes no growth at all takes place.

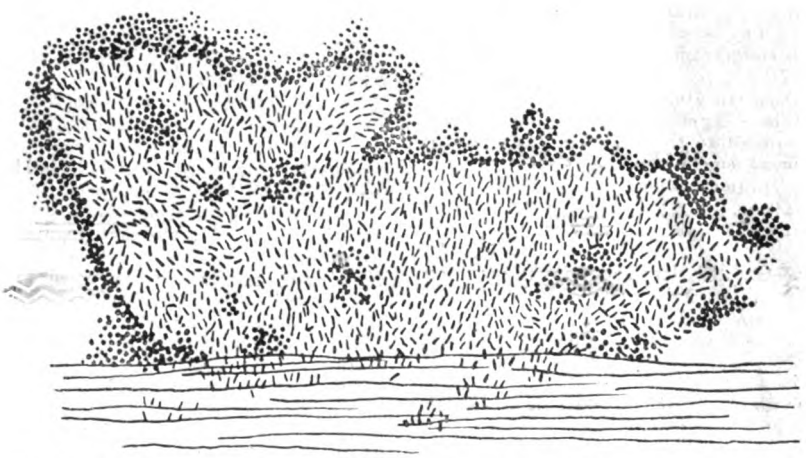


FIG. 4.—Trichomycosis nigra. Note masses of bacillary hyphæ of *Nocardia tenuis* and masses of black pigment-producing coccus.

Classification of the Organism.—As the fungus is morphologically yeast-like, it comes under the general heading "Yeast-like Fungi."

This yeast-like fungus never shows presence of asci; mycelium is completely absent; the budding takes place by one budding at a time; the organism does not produce a thick pellicle in fluid-sugar media; it should therefore be placed in the genus *Cryptococcus*. The peculiar flask-like appearance often shown by this fungus might be an argument to place it in another genus, the genus *Pityrosporum* Sabouraud 1895, which is said to differ from the genus *Cryptococcus* as follows:—

(1) The vegetative cells have a flask-like appearance and do not show a well-marked double contour.

(2) It has not been cultivated.

The genus *Pityrosporum* Sabouraud 1895 contains two species, *Pityrosporum ovale* Bizzozzero 1882 and the *Pityrosporum cantlei* Castellani 1908. Morphologically the fungus I have isolated is very similar to *P. ovale*, but it differs from it in the fact that it is of smaller dimensions and is cultivable, and, moreover, certain cells may show a double contour. In my opinion the fungus should be placed in the genus *Cryptococcus*.

(B) *Bacillus vermiculoides* (n.s.).—This bacillus apparently lives in symbiosis with the *Cryptococcus* I have described; I have separated the two organisms with great difficulty, but I now have pure cultures of both. The bacillus is of rather large dimensions, its length varying between 2 and 6 microns; it is often curved in shape. It is Gram-positive, not acid-fast. The optimum temperature seems to be 37° C., but it may grow, though much less abundantly, at a much lower temperature, 22° C., and even less.

Glucose Agar.—Minute colonies somewhat resembling those of certain streptococci.

Gelatine.—Growth very scanty, or absent altogether; no liquefaction.

Serum.—No liquefaction of the medium.

Sugar Peptone Waters.—It produces acidity, but no gas in glucose, levulose, maltose, galactose, and lactose. There is usually no change in the other sugar-peptone waters.

Litmus Milk.—The medium is rendered acid and after a time may become clotted.

Biochemical Reaction of the Associated Organisms.—When sugar media are inoculated with a mixed cryptococcus-bacillus culture, acid and gas are produced, though very slowly, in glucose and levulose; acidity only in lactose, maltose and galactose; litmus milk is rendered acid and clotted. The cryptococcus alone produces no change in any carbohydrate; the bacillus alone produces acidity (no gas) in several carbohydrates.

Symbiosis may play a Rôle in the Causation of certain Symptoms of Disease.—Let me remind the reader that I use the term symbiosis *sensu lato*, that is to say, to denote the close association of two micro-organisms. There is little doubt that in certain diseases due to specific germs, some so-called typical symptoms are not due to the action of the specific germ *per se*, but to the action of the specific germ plus a non-specific germ living in association. Let me bring forth an example such as occurs in everyday practice—scabies. The typical pustular eruption is not caused by the acarus *per se;* it is caused by pyogenic cocci which apparently find the proper condition to multiply and become virulent on the skin irritated by the acarus; and also the acarus may act as carrier for the pyogenic germs. In individuals who wash their hands frequently with disinfectants, such as nurses and surgeons, when they become occasionally affected with scabies pustules are generally absent and the diagnosis may be extremely difficult.

I will mention another condition described and experimentally studied by me some years ago, viz., *copra itch*. This is a condition found in individuals handling copra, and it is caused by a mite present in millions in copra dust. The disease, apart from the presence of burrows, is identical with scabies. The patient complains of terrible itching and a papulo-pustular eruption is generally present. The pustular eruption is caused by the pyogenic organisms, not by the mite *per se* (*Tyroglyphus longior*, var. *castellanii* Hirst).

Yaws.—In all textbooks the statement is found that one of the typical symptoms is the presence of the large nodules capped by thick, bright yellow crusts. These thick, bright yellow caps are not produced by the specific germ of yaws, *Treponema pertenue*, but by associated pyogenic cocci. If the incipient nodules are constantly dressed with perchloride lotion, they enlarge and become the same size as the other nodules, but the yellow crust is practically absent.

Typhoid.—Meteorism, as is well known, is caused to a great extent by defective tone in the intestinal walls. According to certain researches I have carried out, however, the great abnormal distension found in some cases of typhoid may be caused by the association of the typhoid bacillus with other bacilli, especially bacilli of the Morgan group. In two cases, in which the abnormal distension was extremely marked, the bacteriological examination of the fæces revealed the presence of *B. typhosus* and *B. morgani* closely associated, viz., numerous colonies on MacConkey's plates, which seemed to be pure, were composed in reality of the two germs living in symbiosis. Now *B. typhosus* alone produces no gas in any carbon compound, *B. morgani* alone in only a very few. Their mixture in a much larger number.

The Smell of Favus.—The typical smell—so-called mousy smell—found in so many cases of favus is well known. From certain experiments that have been carried out, it would appear that it is not due to the fungus of favus directly, but to associated bacteria which find the favourable conditions of growth in the lesions caused by the Achorion.

Conclusions.—In conclusion, it would appear that symbiosis or the close association of two or more organisms may play an important rôle in biochemical phenomena and in the causation of certain diseases and certain symptoms of disease.

Biochemical Phenomena.—Symbiosis may play an important rôle in fermentation phenomena. As I observed long ago in Ceylon, ordinary baker's yeast *in toto*, which is in reality a symbiosis between one or more saccharomyces and one or more bacteria, gas-ferments in many cases a larger number of carbohydrates than any of the isolated organisms

The mixture *B. typhosus* + *B. morgani* will produce gas in maltose, mannitol and sorbite, while *B. typhosus* alone produces only acidity (never gas) and *B. morgani* alone has no action, viz., does not produce either acidity or gas in these substances.

In addition to activating phenomena, symbiosis may cause inhibitory effects; for instance, *Monilia tropicalis* produces fermentation with gas, of saccharose, but when grown in symbiosis with *B. typhosus* it seems to lose this property.

Diseases.—It seems certain that there are diseases caused by a true symbiosis or association of two organisms, neither of which alone is capable of producing the malady. Trichomycosis rubra, trichomycosis nigra, stomatitis cryptococcus-bacillaris are examples of such diseases.

Symptoms of Disease.—Certain so-called typical symptoms of diseases of which we know the specific organisms, are in all probability due not to the specific germ alone, but to the association of the specific germ plus one or more non-specific organisms. The mouldy or mousy smell of favus is not caused directly by the fungus, but by associated organisms; the typical honey-yellow crusts of yaws seem to be caused by the pyogenic cocci associated with the

specific germ, *Treponema pertenue*. The great abdominal distension in certain cases of typhoid is probably due to defective tone in the intestinal walls, but may be caused or increased to a certain extent by the association of certain bacilli, as for instance, *B. morgani*, to the typhoid bacillus.

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A NEW SPECIES OF *HEPATICOLA* (NEMATODA) FROM THE RAT'S STOMACH.

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ON two occasions reference has been made by the writer (1925 *a* and *b*) to a Nematode found in the lining of the stomach of rats, which was believed to be *Hepaticola hepatica* (Bancroft, 1893). This worm was found by the writer in a rat (*Rattus norvegicus*) at Bologna, Italy. It has more recently been found to occur very frequently in rats (both *R. norvegicus* and *R. rattus*) at Villa Lagarina, near Rovereto, in the Trentino. Specimens collected by Dr. Wassink in Holland have been identified with it, and what was probably the same species has been recorded by Fibiger in Denmark.

Dr. Sambon, who has always been much impressed with the importance of habitat in relation to questions of specificity among parasites, expressed a conviction that this stomach parasite must be distinct from the liver-inhabiting *H. hepatica*. This question, however, could not be decided without a careful comparative study.

Closer examination reveals certain differences from *H. hepatica*, and it appears necessary to describe the worm as a new species. The absence of a spicule in the male seems to warrant its inclusion in the genus *Hepaticola* Hall, 1916, which differs in this character from the other genera of the subfamily Trichurinæ (see Hall, 1916, pp. 19, 30). Apart from this it might probably be referred to *Capillaria*.

The worms inhabit tortuous galleries in the epithelium lining the anterior, or cardiac, portion of the stomach of the host. They evidently wander about considerably, as this part of the stomach is frequently found to be tunnelled extensively with deserted galleries, in which numerous eggs have been deposited by the female worms. Complete and undamaged specimens are difficult to obtain even by careful dissection of fresh stomachs, owing to the extreme slenderness and fragility of the worms and the relative toughness of the overlying epithelium. The following brief description is based chiefly on two males and one female obtained in this way.

Hepaticola gastrica, sp. n.

The male attains a length of at least 22·4 mm. and the female 37·1 mm. The maximum thickness

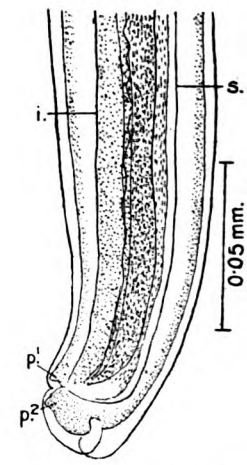


FIG. 1.—*Hepaticola gastrica*. Caudal end of male; lateral view. *i.*, intestine; p^1., preanal papilla; p^2., postanal papilla; *s.*, spicule-sheath.

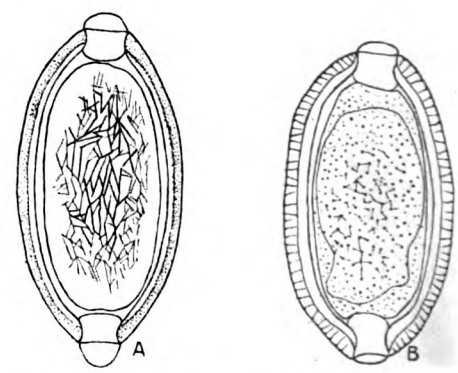


FIG. 2.—Eggs of *Hepaticola gastrica* (A) and *H. hepatica* (B), drawn under the same magnification (Zeiss oil-imm. $\frac{1}{12}$) to show the surface pattern of the shells.

of the male is about 0·065 mm., that of the female 0·09 mm. The diameter at the extremely slender anterior extremity is from 0·007 to 0·01 mm., and at the anus 0·032 to 0·035 mm. in the male and 0·025 mm. in the female. The cuticle has extremely fine transverse striations. The œsophagus is only distinguished with difficulty from the intestine. Its extent, especially in the male, is rather doubtful. In one male it appeared to end at 2·15 mm. from

the anterior extremity, while in the female a more definite line of demarcation occurred at 6·9 mm. from the head end.

The caudal end of the male is bluntly rounded, and appears to terminate in three cuticular lobes, one of which is dorsal and two ventro-lateral. Into the ventro-lateral lobes parenchymatous masses extend, each of which appears to carry a small subventral postanal papilla. There is a long spicule-sheath, which has not been observed in an everted condition, and which appears to contain no spicule. In the introverted condition the sheath is lined with minute spines, which become larger for a short distance towards its anterior end. This region would presumably become the posterior extremity of the sheath when everted, and would probably form a spiny bulb.

In the female the vulva is situated immediately behind the apparent termination of the œsophagus, and from it the vagina and the single uterus run directly backwards. The vulva has rather prominent lips. The uterus contains a single or double row of relatively large eggs, which are longer than the diameter of the lumen, and therefore must lie either parallel to its axis or obliquely to it. The caudal end of the female tapers rather suddenly, but ends in a bluntly rounded and extremely short tail, the anus being subterminal.

The eggs afford the most satisfactory characters for separating this species from *H. hepatica*. The existing descriptions of *H. hepatica* are somewhat conflicting as to the dimensions of the eggs. Bancroft (1893) gives them as 55 microns × 30 to 35 microns. Leidy (1891), in his description of *Trichosomum tenuissimum*, which is probably the same worm, states that the eggs measure 0·04 mm. × 0·032 mm. Travassos (1915) gives the measurements of the eggs of *Capillaria hepatica* (Railliet, 1889), which is again the same species, as 3·060 mm. × 0·028 mm., the extraordinary measurement of the length being evidently due to a printer's error. Hall (1916) states that he finds 52 microns the maximum length of eggs of *H. hepatica*. The writer, however, finds that eggs from the livers of rats, believed to be those of *H. hepatica*, measure from 62·5 to 67·5 microns in length, and from 30 to 32·5 microns in width. The eggs of *H. gastrica*, on the other hand, measure 70 to 72·5 microns × 27·5 to 30 microns. They are thus, on the average, a little longer and a little narrower than those of *H. hepatica*. They are also more regularly lemon-shaped or boat-shaped in outline, those of *H. hepatica* being rather oblong. The extent to which the polar plugs of the shell project is rather variable in both species, and affects the measurements of length considerably. The two layers of the shell are considerably thinner in *H. gastrica* than in *H. hepatica*.

But the most distinctive specific character is found in the surface pattern or ornamentation of the egg-shells. The appearance of "striation" in the shell of the egg of *H. hepatica*, in optical section, has frequently been observed. This seems to be due to minute rod-like structures running through the thickness of the outer shell more or less perpendicularly to the surface, where they appear to end in little refringent knobs or points. These give the surface of the shell a punctate appearance when accurately focused under high powers of the microscope. The refringent points are also connected here and there by very fine lines, giving the appearance of a very fine, irregular network. In the eggs of *H. gastrica* the outer shell lacks the pronounced appearance of striation in optical section, but is somewhat granular. On the surface there is a pattern composed of fine straight lines or ridges running in various directions and forming a network of quite different character from that of *H. hepatica*. The refringent points, and the vertical rod-like structures of which they are the expression in *H. hepatica*, are here absent.

Thus, although the morphological characters of the adult worm do not at present afford very conclusive evidence of its distinctness from *H. hepatica*, it seems necessary, on the ground of the differences in the eggs, to regard the stomach-inhabiting *H. gastrica* as specifically distinct from the liver-inhabiting *H. hepatica*.

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HOOKWORM CONTROL WITH CHENOPODIUM-CARBON TETRACHLORIDE.[1]

By Henry R. O'Brien, M.D.

Bangkok, Siam.

Five years ago Hall [1] called attention to the value of carbon tetrachloride as an anthelmintic. The suggestion was at once caught up, and a succession of investigators have worked out the properties of this drug, both in the laboratory, with the help of dogs and other animals, and in the hospital, where a small number of patients under control could be treated and observed. Egg counts, worm counts, symptoms and autopsies have all contributed their information, until to-day we have a mass of in-

[1] The observations which form the basis of this paper were conducted with the support and under the auspices of the International Health Board of the Rockefeller Foundation.

formation about carbon tetrachloride, its dosage, efficiency and toxicity.

This information is of value to two classes of men. The private practitioner or hospital physician treats but one or two people at a time, individuals whom he has completely under his observation and control. The qualities which he especially desires in an anthelmintic are comfort and efficiency. The public health official has another problem. He must control infection in a whole population, by the treatment of large numbers of people. To do this he must frequently use non-medical men as dispensers, for an adequate supply of doctors is not available or is too expensive. For him the successful anthelmintic must have not only the two qualities mentioned above, but also those of economy and, above all, of safety. In addition, it must deal adequately with the mixed infection which is usually present. To-day he is studying the claims of carbon tetrachloride in the reports of the laboratory and hospital workers, and he asks the final question: "How does it work in the field, in mass treatments?" The first answer to this was furnished by Lambert [2] in his report of 50,000 treatments in Fiji, with three deaths. This paper reports further experience in another tropical field, on a still more extended scale.

The Hookworm Campaign in Siam.

For some years past the International Health Board has co-operated with governmental and other agencies in Siam in carrying on a campaign for the control of hookworm and other intestinal parasites, on the plan of mass therapy (sanitary improvement, of course, formed a phase of the work). Areas were selected because of their high infection rate, and treatments were given, without individual examination, to every able-bodied person who could be induced to present himself. Various drugs were used, but since May, 1925, by far the greatest number of treatments have been given with a mixture of chenopodium (40 per cent.) and carbon tetrachloride (60 per cent.). This mixture combined the efficiency of carbon tetrachloride in dealing with hookworms and the virtues of chenopodium in removing other parasites present. The dilution with carbon tetrachloride served to lessen the discomfort of taking the drug. The mixture was also considerably cheaper than chenopodium alone.

Every precaution was taken to guard the purity of the drugs. "Chemically pure" carbon tetrachloride was purchased in New York, but before being used was retested in the Government Laboratory in Bangkok, and when necessary redistilled and repurified. The chenopodium used was the standard article of good quality available in New York. The mixture was prepared by the field men by adding the measured volumes in quantities sufficient for several days' treatments. Just what deterioration takes place in the mixture on standing we do not know as yet, but instructions were issued to mix enough for only 3-4 days at a time.

Each field unit was composed of one Siamese physician and five or six dispensers. The latter were men of limited education, few of them having completed grade school; their training was also limited. But it is felt that so far as their background and training extended, they were able and conscientious men. These dispensers were scattered in villages about the county seat, and were frequently removed from their medical officer by several hours travel. They were thus thrown much on their own responsibility, both in conducting treatments and in dealing with any complications that arose.

Procedure.

The maximum dosage was 2 c.c. of the mixture. This was less than has been employed in some other countries, but the Siamese are a small people, and in an extended campaign a conservative dose seemed the wisest. The following routine was observed in giving treatments:—

(1) The patient went without breakfast.

(2) At 7 a.m. he was given half the dose of the mixture.

(3) At 8 a.m. he took the remainder.

(4) At 9 a.m. he drank an ounce of magnesium sulphate in hot water.

(5) He was then dismissed with the warning not to take food until after his bowels had moved.

In the case of a child of 15 years or younger the dose was two drops of the mixture for each year of apparent age, taken at one dose in castor-oil. Dispensers were directed to turn away applicants with tuberculosis, heart or kidney disease (they were given simple instructions in the more evident signs), those with acute conditions and pregnant women.

Results of this Series of Treatments.

The active use of this mixture of chenopodium and carbon tetrachloride in Siam began in May, 1925. Between that date and September 1, 1924 (shortly before the author left for his furlough) more than 225,000 individuals were treated with the mixture. This number is exclusive of cases in which for certain reasons other drugs were employed. It constitutes what is believed to be the largest series yet reported in which carbon tetrachloride was used.

In such a campaign a fatality is a thing most to be feared, not only in itself, but also in its effect on public sentiment. In connection with all these treatments with this drug, only three deaths were reported which, on investigation, were found to have no connection with the campaign treatment. Three others occurred, but of these one was a fractured skull in an old man who fell off a porch after treatment, one was a case of miliary tuberculosis (confirmed by post-mortem and examination of sections of liver), and the third was a case of overdose, a curious boy snatching a bottle and swallowing a mouthful of the mixture.

At the same time that this work was being carried on, Smillie and Pessoa [3] were finding that a dose of 2 c.c. of carbon tetrachloride (60 per cent.) and of ascaridol, the purified constituent of oil of chenopodium (20 per cent.) is "highly efficient, compara-

ively non-toxic, easy to administer, and inexpensive." The work in Siam, in which a similar mixture was used under remote campaign conditions, urnishes the field test. That we can report but hree deaths in treating so large a number with this nixture should be a satisfactory and reassuring nswer to the questions of public health workers lsewhere.

SUMMARY.

(1) A standard dose (2 c.c. maximum) of arbon tetrachloride (60 per cent.) and oil of henopodium (40 per cent.) was used in a mass herapy campaign in Siam.

(2) A total of 225,000 individuals were treated vith this mixture up to September 1, 1924, with hree deaths.

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Experiments on the Administration of Quinine in Watery Solution in Olive Oil (J. O. Shircore, J. F. Corson and P. A. Clearkin).—According to the experiments of the authors, quinine sulphate in olive oil, administered intravenously to sheep is, weight for weight, 2·6 times less toxic than a watery solution of quinine bihydrochloride, and may be given up to a maximum of 0·65 gr. per pound of body weight without producing a fatal result.

Primary Carcinoma of the Liver (V. S. Counsellor and H. McIndoe, *Archives of Internal Medicine*, March 15, 1926).—Five cases of primary carcinoma of the liver are described; four hepatomas or primary carcinomas of the liver cells and one cholangioma or carcinoma of the bile ducts. The gross and microscopic appearances have little in common, as the massive, nodular and diffuse forms appear in any microscopic type. The massive form is, however, usually derived from liver cells. All the cases were associated with intrahepatic metastasis by way of the portal and hepatic veins, but in only two were there extrahepatic growths. No transitional forms were found, and the origin is therefore believed to be unicentric. All the cases were associated with cirrhosis of the portal type. The histories in three cases point to a preceding cirrhosis, and in all the microscopic examination of the connective tissue indicated a long-standing process. The relation between the hyperplastic liver tissue and the malignant cells is emphasized. From 3 to 4 per cent. of cirrhosis, particularly of the portal type, become carcinomatous.

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AUGUST 2, 1926.

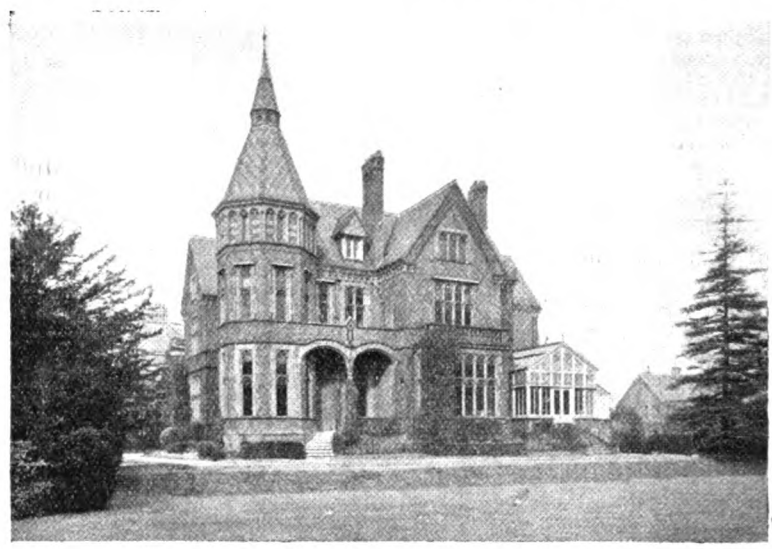
OPENING OF THE ROSS INSTITUTE.

THE Prince of Wales opened on Thursday, July 16, the Ross Institute and Hospital for Tropical Diseases, which has been established at Putney Heath, London, as a memorial to the life-work of

Sir Ronald Ross and as a centre of research and treatment.

His Royal Highness, on arrival, was received by the Duchess of Portland, president, and Sir Charles McLeod, Bart., and after inspecting the institute and hospital he proceeded to the platform in the pavilion. Sir Charles McLeod then presented an address of welcome to the Prince, which stated that the object of the institute was to advance research on every tropical disease and to hand on the results to the schools which taught the subject, both here and abroad, so that tropical and subtropical lands throughout the world might be delivered from the burden which now weighed so heavily on labour and industry and still more terribly on human life. General support had been forthcoming from business houses in all parts of the Empire, from Overseas Governments, and from the Prince of Wales himself.

"Of all these tropical enemies malaria has probably been the most deadly and the most elusive. But now, thanks to the achievement of one man, whose name we are perpetuating in this Ross Institute, its ultimate defeat is certain. Only a few months ago I was able to see in the Sir Alfred Jones Laboratory at Sierra Leone not only the vital need for a campaign against malaria, but also the remarkable progress which has already been made in it. Perhaps I am biased by many visits to tropical and subtropical parts of the world where malaria is rife, and by having talked with so many men and women whose health has been shattered by a life's work in such districts, but I can think of no other single discovery in recent times which will earn the deep gratitude of so many thousands of human beings of all nationalities as the discovery made in India by Major Ronald Ross—as he then was—on August 20, 1897. The story of its subsequent development



The Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S.W.

Sir Charles then handed His Royal Highness a gold key and asked him to declare the institute open.

The Prince of Wales, in reply, said:—

" The opening of this institute, which I am glad to perform, commemorates a definite achievement in the work which the British Empire has done for civilization. Not the least important obligation which the development of that Empire has laid on the members of our race is the constant struggle against disease in all the varied forms it can assume in different climates and in different latitudes. The struggle is always fiercest in the tropics, where man, and especially the white man, is the continual prey of diseases from which we in this country are, comparatively speaking, protected by a more temperate climate; and perhaps the saddest page in the whole history of our Empire is that which tells of the terrible toll taken by plague and by fever of those who helped to build it.

and of what it has led to is well known to you all I need only summarize it in the words of a famous writer: ' It is not too much to say that Sir Ronald Ross has made a third of the world inhabitable.'

" Over a quarter of a century had elapsed since that epoch-making discovery, and this institute and hospital now stands as a memorial to the life-work of Sir Ronald Ross and his colleagues. But it is not merely a passive memorial to work accomplished in the past; it is also, as Sir Charles McLeod has just reminded us, a very active centre for work to be done in the future. All who have any experience in the tropics will know that there is still a vast field for scientific medical research, and here, with all the resources that modern science can provide, such research can be effectively carried out, provided adequate funds are forthcoming. From this building may issue results which will bring back health to thousands who have lost it, or safeguard the lives of those countless others threatened

unseen dangers in tropical lands. More than at, it may open out, for the use and benefit of ankind as a whole, huge districts which are at esent denied to civilization.

"It is not surprising, therefore, that when the heme for founding this institute was first put rward it immediately received widespread public pport. That support happily made its inception ssible, and once the first financial obstacle was rmounted its promoters lost no time in making a reality. To the president, the Duchess of rtland, to Sir Charles McLeod and Mr. Shakeeare, and to Sir Ronald Ross and his two corectors, Sir William Simpson and Dr. Castellani, ie gratitude of all of us is specially due for the me and energy they have devoted to its execution. hey and their fellow officers of the institute may ell feel proud of the result of their labours and the knowledge that they have called into being mething which cannot fail to be of incalculable enefit to many generations.

"It is with the sincere hope that further public upport for the necessary endowment may be forthoming and that the labours of those who will work ere may be blessed with every success that I now eclare the Ross Institute and Hospital open."

The Duchess of Portland, in proposing a vote of hanks to the Prince of Wales, said that they were rateful for his appreciative and sympathetic words. He had spoken from personal knowledge and observation. His Royal Highness never shrank from any personal trouble in promoting philanthropic objects.

Sir Ronald Ross, Director-in-Chief, in seconding the motion, said that the words of the Prince would bring vividly before everyone in the British Empire some sense of the terrible loss which malaria inflicted on the world and some idea of the need to overcome it. He would like to acknowledge the ready and generous assistance given by more than 1,000 contributors, headed by His Royal Highness. Many of these were scattered throughout the Empire, and even beyond it. No fewer than fifteen of our tropical dependencies and as many as eight rulers of states had helped; hundreds of companies and business houses had added their names to the list and many private persons had assisted sometimes out of their humble incomes. He was most grateful for the kind manner in which the Prince had referred to his (Sir Ronald's) work. Hundreds of workers in the field of tropical medicine had "done their bit," if it were only in the trenches. He himself could only expect to view from afar the promised land of a perfectly sanitated world, but they must all endeavour to leave that institute in the best possible condition for future use as a centre for study and a home for sound research. The Prince of Wales, in reply, said he was only too happy to be associated with the institute and hospital, which was doing such a splendid work, not only in this country, but throughout the whole Empire.

The Ross Institute is a fine building standing in its own grounds on the border of the famous Putney Heath. There are two up-to-date wards and several splendidly equipped laboratories, and a good library.

The President of the Institute is Her Grace The Duchess of Portland; Chairman, Sir Charles McLeod, Bart.; Vice-Chairman, Mr. Walter Shakespeare; Director-in-Chief, Sir Ronald Ross; Directors, Sir William Simpson and Professor Aldo Castellani.

Several research workers have already taken advantage of the facilities offered by the institute and have carried out investigations on various subjects.

Annotations.

Syphilitic Myocarditis in the Rabbit (W. H. Brown and L. Pearce, *Journal of Experimental Medicine*, April 1, 1926).—In the course of routine post-mortem examinations of rabbits infected with *Treponema pallidum*, six cases of pronounced granulomatous myocarditis were encountered. Treponemata were not demonstrated in the lesions, but the clinical history, and the gross and microscopic appearance of the lesions, seem to warrant a diagnosis of syphilitic myocarditis. The lesions measured 1·0 cm. or more in diameter and histologically were practically identical with those described by Warthin in cases of syphilitic myocarditis in man. These are the first cases of syphilitic myocarditis or of visceral syphilis in the rabbit that have been reported.

Calcium Absorption from the Intestinal Tract in Human Subjects (B. S. Kahn and J. S. Roe, *Journal of the American Medical Association*, June 5, 1926).—This experimental study showed that calcium lactate administered orally to human subjects causes elevations of the blood-calcium level. 20 grm. doses gave an average maximum elevation of 81 per cent. between the fourth and fifth hours following administration, and a sustained elevation above normal for approximately four hours. 5 grm. doses gave an average maximum elevation of 80 per cent. between the sixth and seventh hours following ingestion, and maintained an elevation above normal for approximately nine hours. 2 grm. gave an average maximum elevation of 41 per cent. at the sixth hour following ingestion and a sustained elevation above normal for one and one-half hours. These findings are in disagreement with the work of many investigators, who have asserted that the blood-calcium concentration cannot be increased by the oral administration of calcium salts, and they confirm the work of Hjort, who found definite elevation of the blood-calcium in dogs given calcium salts by mouth. 5 grm. appears to be the dosage of calcium lactate that will give optimal results therapeutically.

Cultivation of Rickettsia-like Micro-organisms from the Rocky Mountain Spotted Fever Tick,

Dermacentor andersoni (H. Noguchi, *Journal of Experimental Medicine*, April 1, 1926).—A systematic study of seventy-four ticks, the infectivity or non-infectivity of which was determined by biting experiments, inoculation of emulsions, and specific immunity tests, showed the presence in some instances of several types of micro-organism of spotted fever. The most frequently isolated was *Bacterium rickettsiformis*, n. sp., those less commonly encountered were *B. pseudoxerosis*, n. sp., and *B. equidistans*, n. sp. These organisms are non-pathogenic for the guinea-pig, rabbit, or *Macacus rhesus*. In morphological features they resemble the forms found in smears and sections of the ticks, yet their presence had no relation to infectivity. Immunologically they are not related to the spotted fever virus. All three are pleomorphic under cultural conditions, and the question arises whether or not the minute non-pathogenic *Rickettsia* forms and the somewhat coarser symbionts found in *Dermacentor andersoni* are morphological variations due to variations in nutrition, oxygen tension, tissue reactions, &c., in the different tissues and cells in which the organisms are embedded. At all events, the differentiation of the non-pathogenic Rickettsia-like organisms from *Dermacentroxenus rickettsi* is extremely difficult. In definitely infective ticks intranuclear forms were not constant. A point of special interest is that these non-pathogenic micro-organisms from ticks grow best at room temperature, in this respect resembling culturally certain flagellates inhabiting the alimentary tract of insects. The difficulty of obtaining initial growth on artificial media and the gradual adaptation to less specialized media are notable characteristics of these organisms. The possibility that *B. rickettsiformis* is a non-pathogenic phase of the spotted fever organism, comparable with the avirulent flagellate culture forms of leishmanias, seems remote in view of the negative immunological findings. Hereditary transmission of *B. rickettsiformis* is clearly indicated by its presence in large numbers in ovaries and egg cells, a characteristic also of the spotted fever organism and of other insect-borne rickettsiæ.

Reviews.

A General Consideration of Snake Poisoning and Observations on Neo-tropical Pit-vipers By Afranio Do Amaral, of the Serum-Therapeutic Institute, Butantan, Brazil. Humphrey Milford, Oxford University Press. 10s. 6d.

A collection of reports of studies carried out in the Herpetological Laboratory of the Museum of Comparative Zoology, and in the Harvard School of Public Health. It consists of (*i*) a general review of snake poisoning, and (*ii*) a critical study of specific external characteristics of certain Brazilian pit-vipers.

The general review deals with the anatomy of the poison gland and the physical properties of the poison. Toxicity of a given poison appears to be most active on animals which are the natural food.

Little is known of the chemical composition of the toxins, generally considered to be a form of protein, but E. Faust claims to have separated a non-albuminous active principle in certain cases. Whatever the nature of the poison it appears to contain in varying degree substances which produce proteolysis, cytolysis and paralysis of the respiratory centre. A fibrin ferment is sometimes present, at others an antifibrin ferment. The specific action of the poison of various snakes is described.

Treatment of snake-bite. The serum treatment is the sole means of neutralizing the poison and arresting the noxious action which the several toxic elements exercise on body tissue.

Serum treatment, to be highly efficient, should be specific, but the Butantan Institute has produced a polyvalent anti-ophidic-serum. Emphasis is laid on the necessity for intelligent administration of serum. If properly prepared and well administered fatal accidents should be rare.

The remaining papers are purely zoological. The external characteristics of certain Brazilian pit-vipers are critically described. These are well illustrated with several excellently got up plates.

Medical News.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE.

(Division of Tropical Medicine and Hygiene)

Examination Result 80th *Session*, *March-July*, 1926.

Passed with Distinction: R. Crawford (winner of "Duncan" and "Lalcaca" Medals), E. G. Sayers, J. C. Paisley, I. G. MacGregor, W. Thomson, R. W. Thomas, T. C. Wakefield, R. B. Jackson, K. A. MacKay, J. A. W. Ebden, A. F. Babonau, E. Le Clezio.

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Dr. A. T. Stanton has been appointed Chief Medical Adviser to the Secretary of State for the Colonies.

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OBSERVATIONS AND RESEARCHES ON THE EPIDEMIOLOGY OF CANCER MADE IN HOLLAND AND ITALY (MAY-SEPTEMBER, 1925).

By LOUIS WESTENRA SAMBON, M.D.

(*Lecturer in the London School of Hygiene and Tropical Medicine*).[1]

THANKS to the strong and continued support given me by the "Tropical Disease Prevention Association," I was able to continue my researches on the epidemiology of cancer in Holland and Italy, during the spring, summer and autumn of 1925.

During the Italian expedition, I had the honour of being accompanied and assisted in my researches by Dr. H. A. Baylis, M.A., D.Sc., Helminthologist; Mr. K. G. Blair, B.Sc., Entomologist, and Mr. J. Ramsbottom, O.B.E., M.A., Mycologist, all three of the British Museum (Natural History); by Dr. C. Bonne, Director of the Antoni van Leeuwenhoek-Huis Laboratory (Dutch Cancer Institute), Amsterdam; by Dr. A. Ciurcentaler, retired Chief Medical Officer of the Trentino, Italy; by Dr. T. C. Pan, a graduate of the London School of Hygiene and Tropical Medicine, and by my daughter, Miss J. Sambon, a temporary Preparator in the Zoological Department of the British Museum (Natural History).

During our stay in Italy, Professor F. Hobday, C.M.G., F.R.C.V.S., F.R.S.E., joined us and helped us in our work for a short period, while Dr. A. Leslie Sheather, M.R.C.V.S., and Dr. W. H. Andrews, M.R.C.V.S., helped us in our experiments at home.

Financed by a grant received from the British Empire Cancer Campaign, we worked in the Trentino, Italy, during the months of July, August and September. We are now continuing our laboratory researches at home with material brought back from Italy.

In Italy, the Commission received every possible assistance from the Italian Government, the Local Authorities, and the District Medical and Veterinary Officers. Particularly are we indebted to Dr. E. Weiss, Chief Medical Officer of the Province of Trento; to Dr. Bezzi, Director, and Dr. Giuseppe Gilli, Chief Surgeon of the Municipal Hospital of Trento; to Commendatore Giulio Catoni, Director of the Provincial Agricultural Institute of Trento; to Dr. Pierandrei, Superintendent of the Municipal Abattoir of Trento; and to Dr. Enrico Scrinzi, Communal Medical Officer of Villa Lagarina.

To this report of the recent Italian investigations I propose to add a very brief preliminary account of the researches I made in North Holland, Friesland and Zeeland last Spring, together with Dr. Bonne, of the Dutch Cancer Institute; Dr. J. van Dam, of Rauwerd, in Friesland; Dr. C. Bakker, of Broek, in Waterland; Dr. Vieugels Schutter, of

[1] Report submitted to the Committee of the Tropical Disease Prevention Association, December, 1925; printed and submitted to British Empire Cancer Campaign, January, 1926. Authorization to publish obtained July 20, 1926.



FIG. 1.—Villa Lagarina.

Oosterland, in the Island of Schouwen-Duiveland, and others.

The object of these expeditions was to continue and extend researches on the epidemiology and ætiology of cancer made in Italy in 1924 with the help of a grant received from the British Empire Cancer Campaign; also in Iceland and Italy, in the autumn of the same year, with financial assistance received from the Tropical Disease Prevention Association and from personal friends.

The Italian researches of 1924 led to the discovery that in the village of Villa Lagarina, near Rovereto, in the valley of the Adige, during the last half century, cancer had been prevalent, but limited in incidence to one section of the village and more par-

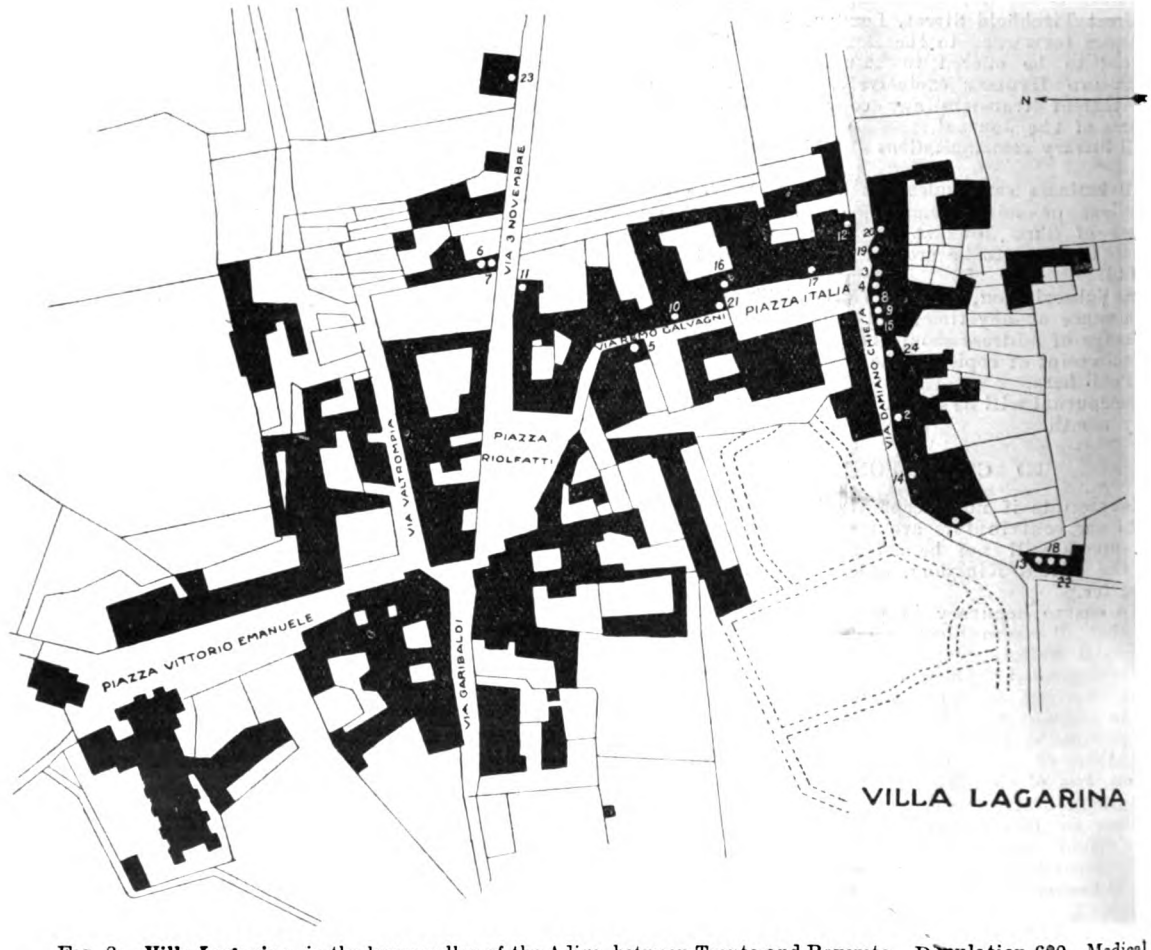


FIG. 2.—**Villa Lagarina**, in the lower valley of the Adige, between Trento and Rovereto. Population 680. Medical Officer of Health: Dr. Enrico Scrinzi.[1] During last 42 years (1884-1925), 24 cancer cases (11 males, 13 females). Distribution striking. Disease limited to one section of village. Via Damiano Chiesa and immediate neighbourhood particularly affected. One house, 5 cases, another, 3.

Year of decease, sex and age of cases in chronological order: (**1**) 1884, M., 60; (**2**) 1884, F., 58; (**3**) 1884, F., 76; (**4**) 1885, F., 77; (**5**) 1885, F., 81; (**6**) 1885, M., 78; (**7**) 1891, F., 71; (**8**) 1892, F., 70; (**9**) 1893, F., 57; (**10**) 1893, F., 67; (**11**) 1897, F., 50; (**12**) 1905, F., 67; (**13**) 1909, M., 73; (**14**) 1911, M., 64; (**15**) 1912, F., 63; (**16**) 1915, M., 76; (**17**) 1917, M., 62; (**18**) 1920, M., 50; (**19**) 1922, M., 77; (**20**) 1923, M., 72; (**21**) 1924, F., 56; (**22**) 1924, M., 58; (**23**) 1924, F., 55; (**24**) 1925, M., 49.

Visceral location of tumour: Stomach, 17 (1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 17, 18, 19, 21, 22); oral cavity, 3 (16, 20, 23); breast, 2 (9, 15); site not mentioned, 2 (2 carcinoma, 24 sarcoma).

Relationship: 8, 9 and 15 sisters, also nieces of sisters 3 and 4; 24 nephew of 11 and 21; 18 and 22 brothers, also grand nephews of 1.

At the time of our visit there were no known cases of cancer in Villa Lagarina. The nearest case was one of the breast in the adjoining hamlet of Pederzano (see fig. 3).

[1] Black patches on this map and following represent blocks of houses.

ticularly to the Via Damiano Chiesa. This striking restriction of the disease, of which we had definite information, demanded careful investigation, especially as it was neither unique nor fortuitous, but repeated, though not so strikingly, in several towns and villages of Italy and other countries.

Such limitations, as well as sundry peculiarities noticed in the topographical distribution, visceral location, seasonal incidence, and periodic fluctuation of cancer, were incompatible with the prevailing ætiological theories which ascribed the disease to certain foods, beverages or drugs, to lack or excess of vitamines, to heredity, embryonic remains, endocrine disturbances, to constipation, or to civilization.

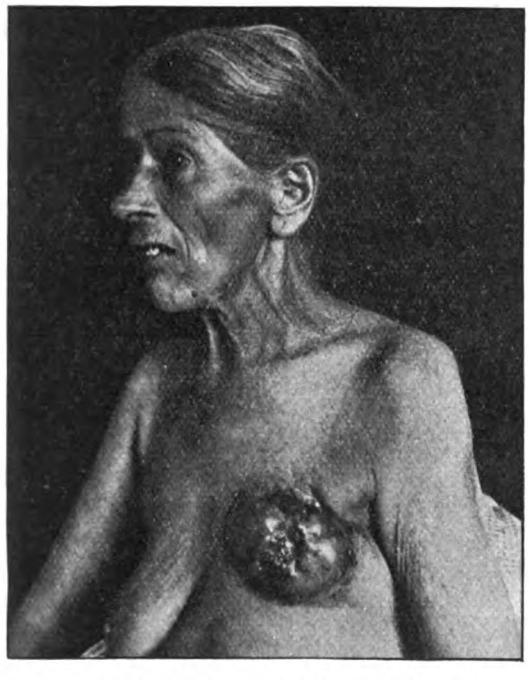


FIG. 3.—Case of breast carcinoma from Pederzano, near Villa Lagarina.

They forcibly suggested an infection of specific nature, probably dependent for its transmission and development on intermediary agencies with like distribution and, if animate, with correlative bionomics. Therefore I proposed making, in Villa Lagarina and other suitable villages, a comparative study of the flora and fauna of houses with and without cancer cases, in order to find out whether household pests such as fungi, cockroaches, cellar-beetles, meal-worms, bed-bugs, rats or mice were present, and whether they played any part in the incidence of the disease, or if any parasites, fostered by house vermin, might be concerned.

Further, on account of Erwin Smith's important researches on " crown-gall " in plants, the discovery of *Bacterium tumefaciens* in man by Friedmann and Magnus, as well as the recent experiments of Blumenthal, who claims to have produced malignant growths in animals by the inoculation of the crown-gall virus, I decided to make inquiries into the distribution and prevalence of crown-gall in the districts visited.

EPIDEMIOLOGICAL RESEARCHES.

The writing up of the epidemiological part of our work, to which I attach considerable importance, will require some time owing to the amount of statistical data that have to be collated and carefully verified and, further, on account of the several maps and diagrams which have to be prepared and cannot be completed, until all necessary data are at hand and have been satisfactorily checked. Dr. Ciurcentaler is continuing to help us in this arduous work with great zeal and proficiency.

A considerable amount of our time was devoted to the verification of data in Villa Lagarina, S. Michele of Appiano, Lavis, Lases, Mezzana, Mezolombardo, as well as other villages which presented a more or less obvious localization in the incidence of cancer.

I am glad to be able to affirm that our data have been subjected to the close, reiterated reading of death registers, the repeated inspection of localities and houses affected, the examination of cancer patients, and to the pertinent inquiries made at the residences of people who had died of cancer, by Dr. Ciurcentaler and myself with the aid of local authorities, physicians, and village-elders. During part of the time we were joined in this work by Dr. Bonne and other members of the Commission.

We were particularly anxious to ascertain, so far as possible, the perfect exactness of the data supplied by the local health officers and already in part verified by Dr. Ciurcentaler. This attitude of meticulous care was taken in order to establish, as firmly as possible, the truth of localism and other peculiarities of distribution which, if real, should prove not only of epidemiological interest, but of great value in the elucidation of the ætiology of cancer.

For each fact of special interest in town, village, or hamlet, I now hold official documents duly stamped and signed by the local mayor, ecclesiastical authority, district or communal medical officer and municipal secretary.

The value of statistics is always relative, and, personally, I am particularly sceptical about cancer statistics as now collected and " corrected," but in a small community such as Villa Lagarina, where there are two very capable native physicians, one, the father, with a local experience of over forty years, the other, the son, fully versed in the methods of modern medicine, there can be no great risk of error. Besides, Villa Lagarina is at a short distance from Trento and Rovereto, therefore its cancer cases are sent for operative or X-ray treatment to either of these towns, both of which possess well-equipped hospitals and excellent surgeons. Trento, moreover, has a young pathologist competent to make the necessary histological examinations.

In distant out-of-the-way places, more especially in the case of old data registered by physicians long dead, or by a priest or municipal secretary, the official figures can have but little value. Then, again, until quite recently, the diagnosis of cancer often was masked by denominations such as " stomach degeneration," or " senile degeneration," so, at times,

it was a difficult question for us to decide whether some of these " degeneration " cases should be regarded as cases of genuine cancer.

Though necessarily obliged to postpone for a while the complete publication of our epidemiological researches with accompanying maps, diagrams and figure-tables, I beg to submit very briefly some of the more interesting facts gleaned through my recent investigations in the Netherlands and Italy.

The recent researches have fully confirmed my previous findings and brought out in the clearest possible way that:

(1) Cancer distribution and prevalence vary from place to place, often considerably, irrespective of climate, race, food, type of dwelling, habits and customs.

I have seen cancer—indubitable cancer—in the north of Iceland, almost within the Arctic Circle,



FIG. 4.—View of the upper valley of the Adige.

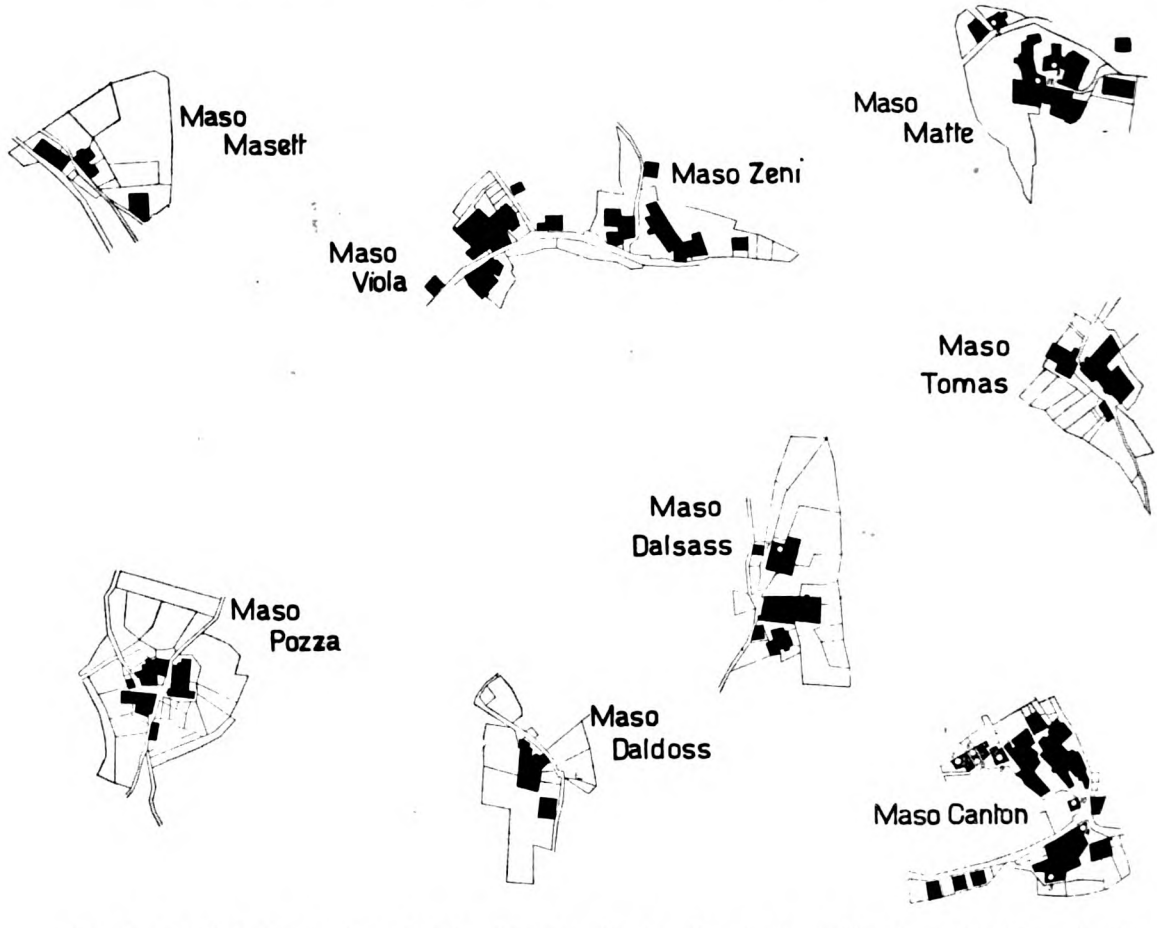


FIG. 5.—**Cavedago**, in the valley of the Non (about 9 miles from Mezolombardo, Trentino. Population 878. This Commune consists of twelve " frazioni " (sub-divisions) or hamlets scattered over the slope of Mount Cavedago, within a radius of less than 1½ mile. (*Only 9 hamlets shown on map.*)

Within the last 42 years (1884-1925) 11 cancer cases (5 males, 6 females) occurred, but they were limited to the three hamlets of Canton, Sass and Matte, the other nine, so far as known, always have been immune. Canton (population 278), 7 cases; Matte (population 136), 3 cases; Dalsass (population 79), 1 case.

Year of decease, sex and age of cases in chronological order: (**1**) 1890, F., 55; (**2**) 1897, M., 65: (**3**) 1898, F., 54; (**4**) 1900, F., 52; (**5**) 1902, M., 67; (**6**) 1907, M., 56; (**7**) 1914, M., 64; (**8**) 1915, F., 56; (**9**) 1917, M., 76; (**10**) 1918, F., 78; (**11**) 1924, F., 77.

Visceral location of tumour: Stomach, 4 (2, 6, 9, 10); œsophagus, 1 (7); larynx, 1 (11); rectum, 1 (3); uterus, 1 (8); location not indicated, 3 (1, 4, 5).

and in the Islands of Trinidad and Grenada, in the Torrid Zone, twelve degrees below the Tropic of Cancer. I have seen it in Dutch villages situated on reclaimed land, actually below sea level, and in Italian hamlets perched at glacier heights on the Eastern Alps. I have seen it in filthy hovels with offensive dung-pits digged at the very door, as well as in the gaily painted, highly-polished and spotless cottages of Broek, a quaint Dutch burgh noted for its exquisite cleanliness. I have found it among the fish-eaters of northern islands, the meat-eaters of merry England, and the vegetarians of Italy and the West Indies; I have found it among low-ground wine-bibbers and mountain milk-drinkers. Yet, everywhere, even in districts covering the smallest area of plain, valley or mountain, one finds villages, or groups of houses totally or partly immune, by the side of others severely affected.

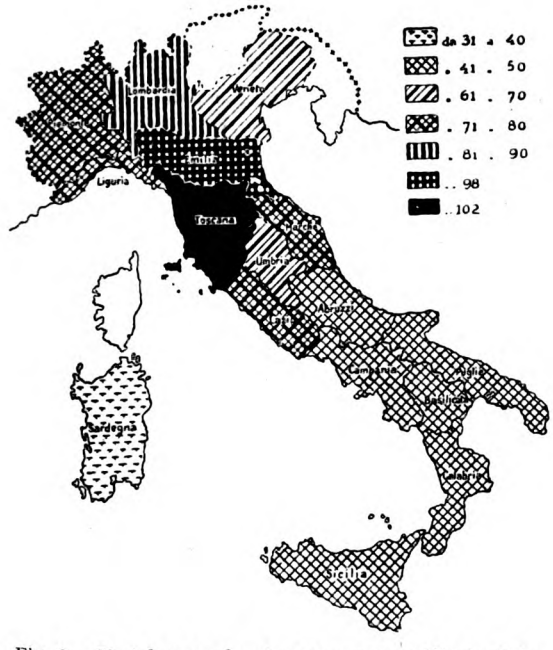


Fig. 6.—Sketch map showing cancer mortality in Italy, 1914-1918, pro 100,000 inhabitants.

To give an example, I might mention the district of Cavedago, in the Trentino. It consists of twelve "frazioni" (sub-divisions or outparts of a parish) or hamlets scattered about the slopes of Mount Cavedago. One of these, Canton, with 278 inhabitants, records seven deaths from cancer between 1885 and 1925; two others—Dalsass and Matte—have had only four cases between them during the same period of forty years, whilst the remaining nine are, and, so far as known, always have been, immune.

As Frederick L. Hoffman states in his valuable work on "The Mortality from Cancer Throughout the World": "The fact is incontrovertible that an enormous range in cancer frequency is met with throughout the world, and that as yet no generally accepted theory in explanation of such a wide degree of divergence has been advanced."

Striking inequalities in the topographical distribution of cancer have been noticed and reported again and again, yet, so far, they have not received the attention they deserve. Properly investigated they should inevitably lead to the elucidation of the ætiology of cancer.

(2) The organs, or parts of the body, more frequently affected by cancer vary, not only in countries far removed from one another, but also, and often strikingly, in adjoining districts.

No less striking than the great inequality in the geographical and topographical distribution of cancer is the diversity of its repartition by organ, or

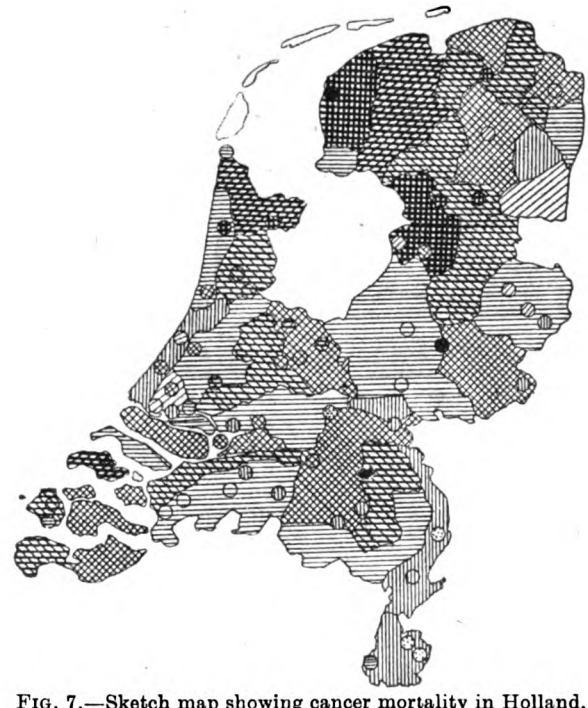


Fig. 7.—Sketch map showing cancer mortality in Holland, 1911-1915, pro 10,000 inhabitants.

part of body, in different countries and localities. Some of these differences are well known, such are the rarity of cancer of the female breast in Japan compared with its great frequency in England; the extraordinary frequency of penile cancer in certain parts of Asia, contrasting with its rarity in Europe and America; the great prevalence of primary hepatic cancer in certain coast-districts of Asia and its rarity in Europe; the commonness of cancer of the stomach in Europe, its rarity in Asia.

Differences in visceral location just as striking are found in different animals; such are the great frequency of mammary cancer in she-cat and bitch, its extreme rarity in the cow; the very common occurrence of cutaneous epithelioma in the dog,

its scarcity in stallion and bull; finally, the great rarity of cancer of the alimentary tract in animals as compared with its frequency in man.

(3) As a rule, cancer cases seem to be distributed in groups or clusters. A first case usually is followed by one, two, three or more cases, either in the same house, or in adjoining or neighbouring houses, the successive patients being sometimes related, more often not

This peculiar group distribution of cancer cases I have noticed repeatedly in Iceland, England, Holland and Italy.

In Holland, Dr. H. T. Deelman already had published in 1920 a very interesting work on the main distribution of cancer in the Netherlands, based on carefully collected and expertly handled statistical data, while a Friesian country doctor, Dr. Jacob van Dam, had written a paper on the distribution of cancer in his own district—that of Rauwerderham—and in the district of Idaarderadeel which adjoins.

Dr. Deelman's maps show, at a glance, that the prevalence of cancer in the Netherlands is, as in every other country, most unequal. Dr. van Dam's work deals, not with lumped statistics, but with local data personally and most carefully collected. Therefore it is of the greatest possible value. If all district medical officers had done the like, the ætiology of cancer might be no mystery.



FIG. 8.—Village of Rauwerd, Holland. (Photo by Dr. C. Bonne.)

FIGS. 9 and 10.—**Vermiglio,** near Tonale Pass, Trentino. Medical Officer of Health: Dr. Paolo Melchiori.

Distribution.—The characteristic group distribution of cancer is well exemplified in Cortina and Fraviano, two "frazioni" or divisions of the Commune of Vermiglio.

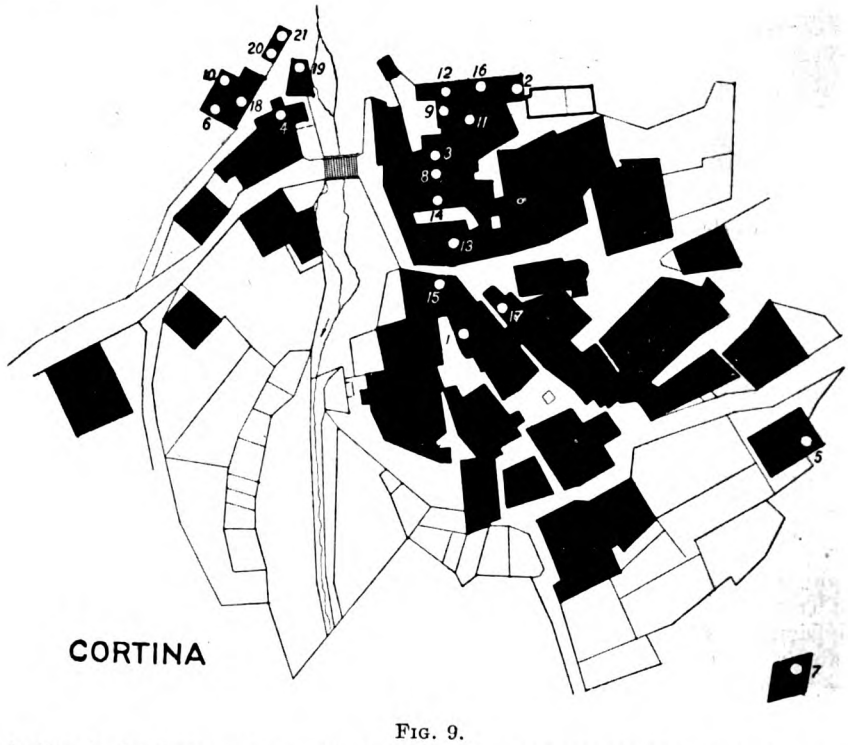


FIG. 9.

Cortina.—Cortina is the larger "frazione." During the last 42 years (1884-1925) 21 cancer cases (12 males, 9 females). According to Dr. Melchiori, the disease started in two houses placed, almost opposite, one on each side of the Cortina stream. Since 1885, these houses presented, one 4, the other 3 cases, in persons more or less related.

Year of decease, sex and age of cases in chronological order.—(**1**) 1885, M., 60; (**2**) 1886, F., 63; (**3**) 1886, F., 64; (**4**) 1900, M., 55; (**5**) 1901, F., 49; (**6**) 1902, M., 74; (**7**) 1903, F., 53; (**8**) 1906, F., 54; (**9**) 1907, F., 71; (**10**) 1908, M., 47; (**11**) 1912, M., 81; (**12**) 1912, M., 66; (**13**) 1914, M., 52; (**14**) 1915, F., 58; (**15**) 1916, M., 56; (**16**) 1916, M., 60; (**17**) 1918, M. 57; (**18**) 1923, M., 57; (**19**) 1925, M., 49; (**20**) —, M., 74; (**21**) — F., ?.

Visceral location of tumour: Stomach, 13 (1, 6, 7, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20); liver, 2 (4, 16), sigmoid flexure, 1 (9); breast, 1 (3); uterus, 2 (5, 21); face, 1 (8); ovary, 1 (2).

Relationship: 12 brother of 6; 8 and 14 sisters; 10 nephew of 8 and 14; 10 nephew of 6; 17 cousin of 8 and 14; 11 husband of 9 and 21 wife of 20.

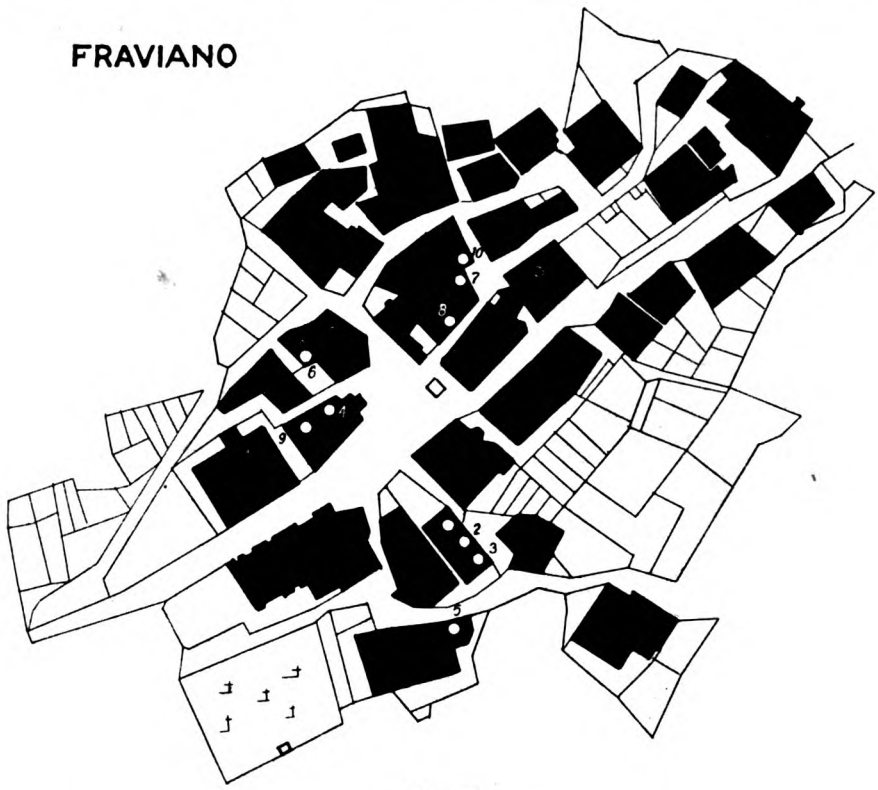


FIG. 10.

Fraviano.—During same period of 42 years 10 cancer cases (3 males, 7 females).
Year of decease, sex and age: (1) 1889, F., 75; (2) 1895, M., 60: (3) 1896, M., 53; (4) 1904, M., 26; (5) 1908, F., 52; (6) 1909 F., 43; (7) 1917, F., 53; (8) 1924, F., 68; (9) 1925, F., 53; (10) 1925, F., 76.
Visceral location of tumour: Stomach, 5 (2, 3, 5, 8, 9); rectum, 1 (10); breast 3 (1, 6, 7); sarcoma, 1 (4).
Relationship: 2 and 3 brothers; others not related.

Already at Broek, in Waterland, Dr. Bonne and I were able to recognize this characteristic clustering of cases, but in the village of Zuiderwoude, and in Friesland, in the villages of Rauwerd, Terzool and Sijbrandaburen, the grouping was unmistakable, though perhaps not so marked as in certain Italian villages such as Villa Lagarina, Lavis, Lases, Mezzana, Mezolombardo, San Lorenzo, S. Michele, Rovere di Luna, Vermiglio, and others.

The relationship of cases, in each group, becomes still more evident when we consider the date of each successive case, its connection with other cases, and the organ or part of the body affected.



FIG. 11.—Group of "cancer houses" at S. Lorenzo, in Pusteria.

At S. Lorenzo, in Pusteria, Dr. Hermann Steger took us to see a striking group of "cancer houses" in "frazione" Pflaurenz. It consisted of five buildings: No. 3, an inn, named "Locanda al Pescatore," kept by the family Kofler, in which during recent years four cases of cancer had occurred; No. 4, an adjoining house, also with four cancer cases; No. 5, contiguous to No. 4, with three cases; No. 2, a detached house, with one case, and No. 23, just opposite the inn, with one case.

(4) Often, in a cancer cluster, all, or the majority of the patients, whether related or not, are affected in the same organ, or in the same part of the body.

In my second cancer report (JOURNAL OF TROPICAL MEDICINE, February 2, 1925) I drew attention to the fact that frequently in non-related people inhabiting the same house, or adjoining, or neighbouring houses, one came across two, three, or more persons suffering from the same type of neoplasm usually affecting the same organ, or the same part of the body. I pointed out that, whilst the homotypic transmission of cancer in successive generations of a single family might lead one to consider the theory of hereditary



FIG. 12.—**Mezzana** in Val di Sole, Trentino. Population 950. Medical Officer of Health : Dr. Attilio Gallina. During last 42 years (1884-1925) 42 cancer cases (22 males, 20 females).

Distribution.—Cases appear somewhat scattered, yet cluster distribution is evident, especially when one takes into account changes of habitation as in Cases 11 and 13, who first lived in the house inhabited by Case 1. The various clusters show no evidence of hereditary transmission.

Year of decease, sex and age of cases in chronological order :—(**1**) 1885, M., 55 ; (**2**) 1886, M., 71 ; (**3**) 1886, F., 67 ; (**4**) 1887, F., 43 ; (**5**) 1887, F., 58 ; (**6**) 1887, M., 55 ; (**7**) 1889, F., 60 ; (**8**) 1892, F., 60 ; (**9**) 1892, F., 62 ; (**10**) 1892, F., 65 ; (**11**) 1895, M., 66 ; (**12**) 1897, F., 58 ; (**13**) 1898, M., 69 ; (**14**) 1899, F., ? ; (**15**) 1900, M., 82 ; (**16**) 1902, M., 46 ; (**17**) 1903, F., 43 ; (**18**) 1903, F., 74 ; (**19**) 1907, M., 76 ; (**20**) 1908, M., 82 ; (**21**) 1908, F., 69 ; (**22**) 1911, M., 60 ; (**23**) 1912, F., 45 ; (**24**) 1914, M., 83 ; (**25**) 1915, M., 51 ; (**26**) 1916, F., 72 ; (**27**) 1916, F., 50 ; (**28**) 1916, F., 60 ; (**29**) 1917, M., 62 ; (**30**) 1918, F., 69 : (**31**) 1918, M., 69 ; (**32**) 1919, M., 53 ; (**33**) 1920, M., ? ; (**34**) 1920, M., 61 ; (**35**) 1920, M., 67 ; (**36**) 1922, M., 58 ; (**37**) 1922, F., 48 ; (**38**) 1923, M., 56 ; (**39**) 1923, F., 35 ; (**40**) 1924, F., 66 ; (**41**) 1925, M., 66 ; (**42**) 1925, M., 69.

Visceral location of tumour :—Stomach, 18 (2, 6, 7, 11, 13, 16, 17, 18, 24, 25, 26, 29, 30, 31, 36, 38, 41, 42) ; œsophagus, 1 (22) ; intestine, 4 (34, 35, 39, 40) ; rectum 1 (33) ; peritoneum, 1 (32) ; abdomen, 3 (5, 8, 9) ; thyroid, 2 (10, 27) ; liver or stomach and liver, 4 (12, 20, 21, 28) ; face, 1 (3) ; breast, 2 (23, 4) ; uterus, 1 (37) site not stated, 4 (1, 14, 15, 19).

Relationship.—Only one instance of cancer in parent and progeny : a case not of mother, but of father (11) and son (36). Six and 13 were brothers ; 4 and 41 cousins ; 23 niece of 2 ; 42 niece of 37 ; 33 nephew of 31. Cancer in people related by marriage and living in the same house are frequent : 7 wife of 1 ; 24 husband of 5 ; 17 daughter-in-law of 10 ; 27 daughter-in-law of 15 ; 23 daughter-in-law of 20 ; 3 and 18 sisters-in-law, so also 40 and 41. Still more frequent are the cases of cancer in total strangers inhabiting the same house. In one house we find 4 cases : owner (24), his wife (5) and two non-related lodgers (29 and 38) ; in another, 3 cases (12,25, 34) all non-related.

transmission plausible, this theory could not explain the occurrence of cancer of the same type and location in persons of different stock inhabiting the same house, or in total strangers occupying neighbouring houses. I gave an interesting instance of three cases of cancer of the throat (one of tonsils and pharynx and two of larynx) at Caldaro, " frazione " Mezzavilla, in non-related persons one of whom was only thirty-two years of age when he died. They had been attended by Dr. Carl Konzert, the local health-officer.

Similar cases have been described in medical literature from time to time. Thus, in 1903, in the *Lancet*, Dr. W. Gifford Nash reported a group of five cases, three of which died from cancer of the tongue in one village (North Bedfordshire) within the space of sixteen days.

During our recent investigations we have come across further examples of the kind. For instance, Dr. F. Pizzini, health-officer of Rovere di Luna, stated that five cases had occurred in his district between 1913 and 1925. Of these, four were females belonging to different families and living in different but neighbouring houses: one of them had cancer of the uterus, the other three died of cancer of the breast, an incidence somewhat rare in those parts of the Trentino visited by us. At S. Michele, the local health-officer reported two cases of bladder cancer in the same house: the patients were cousins. In Holland and Italy I have often noticed the appearance of several cases of hepatic cancer in close proximity. Cancer of the liver is very common in many tropical countries, but in Europe it is generally looked upon as secondary to cancer of the stomach and, no doubt, in the majority of cases it is so. However, primary cancer of the liver has been observed in East Prussia (Kurisches Haff) and in Hungary (Kolozsvar). Its presence among the fisher-folk of the Kurisches Haff has been ascribed by Askanazy, Rindfleisch and others to the parasitism of *Opisthorchis felineus*, a

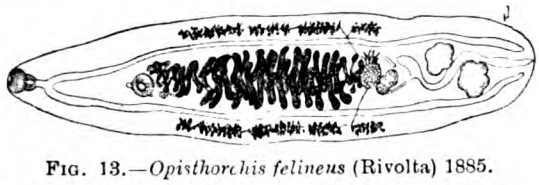


FIG. 13.—*Opisthorchis felineus* (Rivolta) 1885.

tiny liver fluke described in 1885 by Rivolta, who found it in dogs and cats in Italy. I have no longer any doubt as to the occurrence of primary liver cases in certain parts of Italy, but have had no opportunity of studying their ætiology.

At Cesoino, a " frazione " of Pederzano, situated above Villa Lagarina, Dr. Scrinzi took me to see a woman—Elisa Candioli—seventy-six years of age—who had a ghastly rodent ulcer occupying the whole of the frontal region. The frontal bone had been destroyed, exposing the brain and its coverings. From beneath the ulcer's undermined edges fly-maggots (larvæ of *Lucilia*) dropped out with the ichorous, semi-purulent discharge. She had been well-nigh six years in this pitiable condition, but the disease had started long before as a scaly patch on the forehead. She lay moaning on her bed and complained of fearful restlessness at night and of lancinating pains and burning in her head. The stench from her open cancer was unbearable. The lymphatic glands were not perceptibly enlarged. Dr. Scrinzi cleansed and dressed the sore and the poor woman said, " At last I believe I have found someone who shall heal me. As soon as I am well again, I will go straight to Rome and kiss the feet of the Santo Padre."

In the house adjoining, another old woman—Santa Mancia—had died not long before of a similar skin epithelioma. Dr. Scrinzi had seen her and he told me that in her case the corrosive ulcer had started from beneath the right eye and had gradually spread down to the shoulder.

In Donna Candioli's house, we were informed that a cat had been destroyed on account of an extremely malodorous sore at the back of the head. A young girl, who had attended the patient and nursed the cat, presented on the face a peculiar skin disease which Dr. Scrinzi thought, on account of her age, might be lupus rather than a superficial variety of epithelioma.

In tuberculosis, cases of homotypic transmission to descendants had been looked upon, not only as evidence of hereditary transmission of the disease, but also as indicating the transmission of a particular susceptibility or predisposition of the organ affected (lung, kidney or skin, as the case might be). But, I believe, and laboratory experiments bear me out, that the selection of the organ has little to do with the host, but is made by the parasite, or, maybe, by some endogenous carrier and sower of the parasite, if there be one. It is certainly not a greater predisposition to disease that we inherit, but rather a greater resistance against it. Disease overcome, or battled against, in the parent, tends to produce immunity in the child. It is the parasite, nurtured in a certain organ, which invariably makes for that same organ in its successive transmissions to new hosts. The whole science of parasitology teems with proof of this. Therefore, to my mind, it is by infection alone that we can explain the very striking, but frequently occurring, fact of the homotypic transmission of cancer to persons of different stock inhabiting the same house or the immediate neighbourhood of a cancer focus.

(5) Notwithstanding occasional increase in certain localities, decline in others, the relative frequency of regional incidence shows, as a rule, the same remarkable persistence which is characteristic of the " stations " of well-known endemic diseases.

The researches of Moore, in 1865, and those of Haviland, a few years later, show, when compared with recent data, that for about a century, at least, cancer in England has maintained the same topographical distribution and exhibited the same relative prevalence. This is exactly what we find in Italy, Holland, Germany, and other countries.

(6) Notwithstanding general progressive increase or decline, cancer exhibits, in its local incidence, noticeable fluctuations from year to year, such as are witnessed in all endemic diseases.

As pointed out in my first cancer report (JOURNAL OF TROPICAL MEDICINE, June 2, 1924), periodic fluctuations in the incidence of cancer have been noticed in Italy by Professor Foa and by Drs. Testi and Galli.

(7) For a number of years cancer may prevail exclusively in one section of a region, town or village, then affect some other section of the same, whilst continuing, increasing, diminishing, or completely dying out in the section previously affected.

This shifting of the incidence or prevalence of cancer from one locality to another I have observed on several occasions in different countries. For instance, in Italy, at S. Michele on the Adige, a village of 850 inhabitants, we found that fourteen cases of cancer had occurred during the last forty years. For twenty-seven years (1892-1920), with the exception of a single case (see fig. 14, Case 1), at the extreme north end, the disease (Cases 2, 3, 4, 5, 6, 7, 8) had affected only the centre of the village, the cases occurring along the broadway in non-related persons belonging to different families. From 1920 onwards no further cases occurred in this area, the next six (9, 10, 11, 12, 13, 14) cropping up to the north-east of the central section. Case 9 (1920) sickened and died in the house adjoining that of Case 1 (1892), at the extreme north end of the village, but was in no way related; indeed, whilst Case 1 was an Italian, Case 9 was an Austrian. The only instance of family connection between any of the cancer cases in S. Michele was that of Case 10, who was a cousin of Case 13.

On consulting the map, one cannot help noticing the striking propinquity of cases with similar organ location. The three bladder cases (11, 12, 13), like the three uterine cases (3, 4, 8) and the two œsophageal cases (5, 6), are grouped or ranked in close vicinity and so are the stomach cases arranged in pairs.

The inhabitants of S. Michele are mostly well-to-do wine-growers, and the district around the village is a flourishing viticultural centre famous for its dark, rich Toroldic wine, much in request for giving body to lighter wines.

At Mezolombardo, a borough of about five thousand inhabitants and centre of the wine trade of a vast extent of grapeland, cancer first prevailed in the upper and middle portion named Cornel and in the subjacent section called Canovarie (cellarage), where, in days gone by, stood the Bishop's cellars, used to store the ecclesiastical tithes in wine, grain and other provisions, and where many of the inhabitants still bear the name of Kellner (cellarer). Thence the disease spread to right and left, each year more widely, reaching successively Contrada (1885), Piaz (1886), Villa (1890), Ospedale (1900) and even Borghetto (1891)—a group of houses, at



FIG. 14.—**S. Michele-on-Adige,** near Trento. Population, 850. Medical Officer of Health, Dr. Fausto Onestinghel.

During last 42 years (1884-1925) 14 cancer cases (7 males, 7 females). Distribution striking. For 27 years (1892-1920), with exception of first case, at the extreme north end, the disease (cases 2, 3, 4, 5, 6, 7, 8) was confined to the centre of the village. From 1920 onwards, no further cases occurred in this area, the next six (9, 10, 11, 12, 13, 14) cropping up in the north-east of central section.

Year of decease, sex and age of cases in chronological order.—(**1**) 1892, M., age not mentioned; (**2**) 1893, F., 58; (3) 1899, F., 38; (**4**) 1906, F., 53; (**5**) 1911, M., 58; (**6**) 1916, M., 53; (**7**) 1919, F., 73; (**8**) 1919, F., 53; (**9**) 1920, F., 45; (**10**) 1920, M., 75; (**11**) 1921, M., 57; (**12**) 1922, M., 62; (**13**) 1924, F., 66; (**14**) 1924, M., 73.

Visceral location of tumour: Stomach 5 (2, 7, 9, 10, 14); œsophagus, 2 (5, 6); uterus, 3 (3, 4, 8); urinary bladder 3 (11, 12, 13), and 1 of general carcinosis (1).

Relationship: Only instance of family connection, 10 first cousin of 13.

the very end of the borough, where it long exacted heavy toll. Yet the disease continued all the while in the Cornel-Canovarie section where it seemed to have started.

The local health officer, Dr. Roberto Caprera, who had practised in Mezolombardo for nearly thirty years, told us that the prevalence of cancer had greatly declined in recent years. The last cases seen by him were two breast cases, both successfully operated, and one of cancer of the womb beyond surgical interference. In former years cancer was not only more frequent, but its visceral location seemed to be different. The organs more usually affected were the œsophagus, the stomach and the liver. During thirty years he had met with only three uterine cases, whilst in a single year (1907) he had examined three œsophageal cases. He never had seen cancer in husband and wife, nor in parent and progeny, nor, again, did he remember ever having seen more than one case in the same house, though he had noticed a certain grouping of cases in adjoining or neighbouring houses. The food of the people consisted chiefly of polenta (maize-mash) and vegetables, but they also ate a considerable amount of animal food and drank much wine.

Together with Drs. Caprera, Ciurcentaler and Pan, I visited the various sections of the borough, carefully inspecting houses in which cancer had occurred, and I paid special attention to the older Cornel-Canovarie section which is heaped up against the rocky, perpendicular side of Mount Fai. Here the houses are damp, ill-kept and noisome; they are seldom reached by the sun's rays, except for a short time in the early morning. At the very door of each house and right against the wall is a manure pit over which the latrine, projecting from the upper floor, discharges gargoyle-like. Hens and cockerels congregated on the dunghills to feast on the maggots. The houses swarmed with rats, mice and cockroaches (*Blatta orientalis* and *Blattella germanica*). Bedbugs and fleas were not unknown, as we soon discovered, notwithstanding Dr. Caprera's belief that they were prevented from breeding by the large amount of sulphur dust stored in the bedrooms against the powdery mildew (*Uncinula necator*) of the grape vine. Rheumatic fever was very common and just as prevalent in summer as during the spring and fall; it was invariably preceded by sore throat. Diphtheria was also common; sporadic cases cropped up every year, but epidemics did not occur now so frequently as formerly. Poultry, as a rule, suffered simultaneously with a like, or, may be, identical disease and Dr. Caprera told us that he had removed the characteristic false membranes from the birds' fauces.

In 1924, Dr. L. Nègre, of the Pasteur Institute, Paris, made some careful investigations on cancer epidemiology at Labastide-Rouairoux, on the River Toré, between Castres and Saint Pons, in the South of France, "to compare results with those obtained by Dr. Sambon in Romagna." He calls attention to the fact that, whilst cancer cases from 1900 to 1920 were equally divided between the two sections of Labastide, right and left of the river, from 1920 to 1923 the left side (Quartier du Galinel) had twice as many as the right.

Quite recently (1926) Dr. Himburg has drawn attention to an unusual increase of cancer in the village of Nörenberg, in Pomerania, Prussia. Nörenberg has about 2,600 inhabitants. During the years 1900-1913 cancer accounted for nearly 5 per cent. of all deaths, but between 1922 and 1924 the cancer mortality rose to 10 per cent. of all deaths, while in 1925 the percentage was still on the increase. This sudden augmentation is strikingly limited to the village of Nörenberg, contrasting with all neighbouring villages where cancer incidence has remained as it was. The mode of life and circumstances of the inhabitants of Nörenberg differ in no way from those of their neighbours.

(8) Cancer may break out suddenly in a place long immune, then disappear, or it may remain quiescent, at least in so far as man is concerned, for many years..

The village of Idaard, in the district of Rauwerderhem, Friesland, had presented unexpectedly six

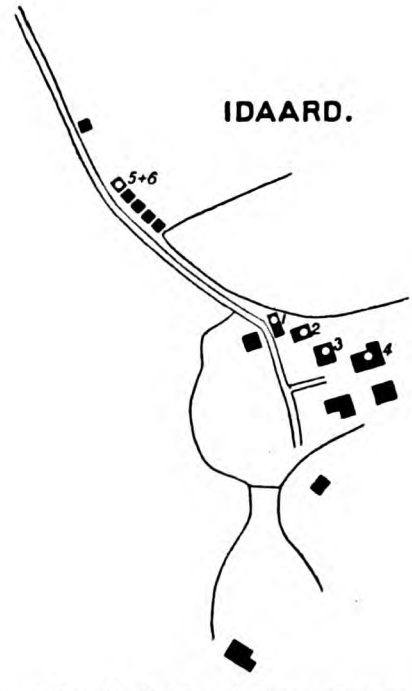


FIG. 15.—**Idaard,** district of Rauwerderhem, Friesland. Medical Officer of Health, Dr. J. van Dam.
This hamlet, at any rate since 1874, had remained immune from cancer; then, between 1912 and 1919, six cases occurred in persons (5 men and 1 woman) non-related.

cancer cases between 1912 and 1915, one each year in a group of adjoining houses. Two others in 1919 in a house at the north end of the village, then no more, as I was able to ascertain at the time of my visit in April, 1925. Prior to 1912 cancer never had occurred in Idaard, at any rate not since 1874, before which year there were no records.

The first Idaard case was one of œsophageal cancer in a shopkeeper who had succumbed to the disease in 1912, then a farmer died of gastric carcinoma in 1913, the third case was that of a teacher, who likewise had died of cancer of the stomach in 1914, and the fourth that of a clergyman, who had died of epithelioma of the face in 1915. All had lived for at least twenty-five years in the village; three of them were natives, whilst one, the teacher, had come originally from Leeuwarden. They were in no way related. The two cases reported in 1919 were: a man—a farm-hand—who had died of cancer of the stomach in October, 1919, and a woman—a housekeeper—who had come from elsewhere and had died of cancer of the vulva and vagina in July, 1919.

When Dr. Bonne and I visited Idaard together with Dr. van Dam, we examined the group of houses in which the first four cases had lived; they were the dwellings of well-to-do people, well-built, well-furnished, spotlessly clean and surrounded by pleasant gardens.

Whilst planning excursions in order to get a glimpse of cancer conditions in the Netherlands, Dr. Bonne told me that he had made arrangements for a trip to Vianen, a small fishing hamlet in the island of Schouwen, Duiveland, Zeeland, whence he showed me a letter received from one of his colleagues. The latter stated that whilst discussing my researches on the epidemiology of cancer, Dr. Vleugels Schutter of Oosterland, Zeeland, had told him that in the hamlet of Vianen, during the last twenty-five years, there had occurred about ten deaths from cancer, but not a single one from any other disease. This information certainly was remarkable.

On May 2, Dr. Bonne and I landed at Zijpe, in the island of Schouwen, where Dr. Schutter met us and drove us to his house in Oosterland. After luncheon we went to Vianen. Whilst driving there, Dr. Schutter told us his district was mainly agricultural; wheat, potatoes and the sugar-beet were the chief crops. The breeding of cattle was limited. There were numerous dogs and one or more cats in every house; rats abounded. Cancer was decidedly prevalent and the people feared it. The least ailment made them think they had the dread disease which some of them ascribed to the spraying of potatoes with Bordeaux mixture (copper sulphate and lime mixture).

We reached Vianen, a cluster of brick and wooden cottages standing on a dyke facing the Eastern Schelde. Behind us was a lakelet blue as heaven, and, beyond, green wheat-fields shimmering in the sunshine. The tide was out, leaving a vast smooth stretch of damp sand, flecked with bronzed seaweed, glittering pools and the silver wings of restless terns and gulls. A very old Dutchman, supporting the bowl of his pipe with a bony hand, was gazing over that pale arenaceous land, wishing, no doubt, that it might never again show as water.

Some of the cottages were ivy-mantled and their gardens hedged with clipped box. At the back were hen-coops and pig-sties and, behind all, the invariable ditch of foulest water. We entered one of the cottages; the walls within were of varnished wood and blue-painted tiles; it was scrupulously clean and tidy.

Along the road bright, red-cheeked children, with china-blue eyes and flaxen hair, ran, jumped, shouted for pure glee of existence, clattering upon their wooden clogs.

The inhabitants of Vianen numbered seventy, all told, and Dr. Schutter assured us that, during the last quarter of a century, there had been no deaths among them save from cancer. To be sure, two men had died of tuberculosis, but one was a total stranger who had died on arrival; the other, a student who had lived for some years in Utrecht, where he had contracted his illness. The Vianen cancer cases numbered nine (stomach 5, liver 1, intestine 1, abdomen 1, jaw 1) since 1900. During the last five years there had been no further cases of cancer and no deaths from any other disease. If one could but trust the dyke and wipe out cancer, there seems to be no reason why the good people of Vianen should not go on living for ever.

(9) Heredity does not seem to be a determining factor.

In his book on "Heredity," Professor J. Arthur Thomson, espousing the theory of "embryonic rests," makes a strange suggestion. He says: "Leaving microbic and acquired diseases out of account, we may safely say that various processes of hypertrophy which are associated with disease in a well-finished organism like man are, as it were, recrudescences of important steps in past evolution. The persistence of germinal activity in a patch of cells may give rise to a tumour, but is it not, as it were, an echo of the power that lower animals have of regenerating lost parts?"

Several laboratory investigators, such as Dr. Leo Loeb, Miss Maud Slye and others, have asserted that in mice there is not only a predisposition to develop cancer definitely hereditary, but that the hereditary transmission of the disease takes place in the true Mendelian manner, and Professor Powell White has even suggested that Dr. Gye has cultivated Mendelian factors *in vitro*.

In the field, studying men, not mice, I have seen nothing of the kind.

Besides, I cannot conceive the hereditary transmission of disease any more than that of mutilations such as circumcision, ear-piercing, ear-cropping, tail-docking which, like the pruning of trees, have been performed for countless generations without ever appearing in the progeny. What we do inherit is not the disease, but a greater power of resistance to it; not the mutilation, but a greater power of repair.

Hereditary traits and characters are said to lie within the chromosomes of the reproductive elements, but, so far, none of the disease-agents known to us has ever been located in the nuclear substance of the germ-cells.

It is true that in Arthropods certain disease-agents do pass from the infected mother to her offspring

through the egg, but in such cases the pathogenic organism is contained in the food-yolk, where it assumes a resting condition and awaits the development of the embryo, which it then attacks. Clearly, such cases are those of infection, not inheritance. Well-known examples are the "hereditary" transmission of *Nosema bombycis*, a microsporidium giving rise to the fatal pébrin disease in the caterpillars of the Chinese silk moth (*Bombyx mori*), and the transmission of *Babesia bigemina*, the cause of cattle hæmoglobinuric fever, effected within its tick vectors. In the latter case the pathogenic organism passes from the adult female tick, gorged on the blood of the diseased vertebrate, to its progeny, which in due time will convey it to a new bovine host. The parasite enters the tick's egg either in the ovary, or during its passage down the oviduct; later it invades the larva, finally reaching the salivary glands when the tick of the second generation, either as nymph or imago, becomes capable of transmitting the infection.

Physicians usually confound heredity with antenatal acquirement. Supposed cases of hereditary transmission in syphilis often are due to contamination of the offspring during transit through the maternal passages at birth, yet infection may occur *in utero* from mother to offspring during the period of gestation, because *Treponema pallidum*, like the trypanosome and other slender and very motile organisms, is able to traverse the placental filter. But the offspring of a syphilitic mother usually dies during fœtal life or soon after birth; rarely it grows, apparently healthy, to succumb to the disease at puberty or senescence.

Since the discovery of its specific germ, tuberculosis is no longer considered hereditary, yet the majority of physicians still hold that one may inherit some kind of "tendency" to tuberculosis. Such a conception which might seem reasonable in a community with high tubercular incidence, is contradicted by the greater susceptibility to the disease in members of non-tubercular communities when the latter, leaving their healthy surroundings, come in touch with tuberculous infection. There is no proof of any specific predisposition, all that can be reasonably maintained is a general constitutional debility favouring any kind of disease, and brought about by ill-nourishment during gestation.

In the case of leprosy, long considered a hereditary disease, it has been proved that the children of lepers, born out of leper districts, never inherit this malady.

At one time helminthic infestations were believed to be hereditary, and indeed the larvæ of certain worms may traverse the placenta and cord.

Reappearance of a disease in successive generations does not constitute inheritance. It is in the environment of members of the same family, brought up in the same locality and subject to the same conditions of life, that we must needs look for the explanation.

During my investigations in Italy and Holland I found that cancer might appear first in the children and later, sometimes much later, in the parents, or almost simultaneously in both. In 1887, in the *British Medical Journal*, Dr. A. Roper reported a case in which husband and wife had no trace of cancer in the history of their families and six of their children died of cancer.

Dr. van Dam, who had made a careful study of the heredity question in his district (Rauwerderhem, Holland), told me that in thirteen cases in which both parents had died of cancer their children were free, notwithstanding that, with few exceptions, all had reached the cancer age.

(10) The habitation of certain premises appears to be a factor of importance, at least whilst as yet undetermined cancer conditions persist.

Cancer in husband and wife was observed in Italy and Holland just as frequently as in England, France and other countries. At other times the primary case was followed by malignant disease in members of the same household, not necessarily in a blood relative or spouse, but in a brother-in-law, or in a sister-in-law, in a step-son or step-daughter, in a maidservant, a lodger, or, maybe, in a cat or dog.

At Coredo, an Alpine village of about a thousand inhabitants, situated on Mount Roen 830 metres above sea level, Dr. Cav. Luigi Ioris, the district medical officer, showed us a so-called "cancer house," now uninhabited, which had belonged to Dr. Luigi Ossana, a local physician, who had died in 1870 from



FIG. 16.—Dr. Ossana's house at Coredo.

intestinal cancer at the age of seventy-five. His death had been followed by the death of his wife, his two sons and his son-in-law, all of whom had lived in the same house and had succumbed to the same disease. The two sons had died, the elder in 1900, at the age of sixty, from cancer of the œsophagus, the younger in 1904 from cancer of the thyroid, when forty-eight years old. The wife had died in 1890 from cancer of the pharynx and tonsils; she was seventy-three years old when she died, and had been married forty-three years. There had never been any cases in her family. The most instructive case was that of the son-in-law, Professor Bartolo Sicher, who had died of cancer of the stomach in 1880 when only thirty-eight years of age. For eight years this gentleman had lived in Dr. Ossana's house. There was no cancer history in his family. A brother and two sisters of Dr. Ossana are still living and well, though very old.

(11) Cancer in dog, cat, fowl, or other domestic animal occasionally may be found in association with cancer in man under the same roof, either preceding or following it.

In my first cancer report (JOURNAL OF TROPICAL MEDICINE, June 2, 1924) I mentioned a few examples of cancer in man preceded, or followed, by malignant tumours in animals. These cases, supplied by Drs. Testi, Galli, Lama, Ghetti, Fedeli, Zanotti and others, were, for the most part, somewhat vague. In Holland I obtained more definite information. First at Broek, in Waterland, together with Drs. Bonne and Bakker, I had the opportunity of examining an eight-years-old draught-dog with an anal tumour of three years standing which had reached the size of a large plum. The local veterinarian, Dr. J. F. de Gier, told us of this dog that lived in a small house, behind the tramway station, where his master had died of cancer four and a half years previously. Examination of the tumour by palpation led us to believe that it might be a fibroma, but the veterinarian removed it on the following day and sent it to the Cancer Institute in Amsterdam. Here Dr. Bonne made sections and found it to be an epithelial neoplasm, a growth termed either adenoma or carcinoma by veterinarians. It affects not the rectal glands proper, but a group of circum-anal glands which open at the margin of the anus, lie under the skin, and are probably of the nature of scent glands. The frequency of this form of cancer in dogs has been put down to injury caused by scraping of the anal region along the ground, so-called "sleigh-driving."

Dr. Parree, who was with us at the time we examined the Broek dog, said that he remembered seeing a dog with a conspicuous growth beneath one of the lower eyelids, in a house in Zuiderwoude where lived a cancer patient.

When in Harlingen, Dr. Bonne and I called on Dr. B. Bosch, who told us that in a house close to his own, in Noorderhaven Street, there was a widow, Mrs. H., fifty-two years of age, who had come from Usquert, a village in the province of Groningen, where she had lived until 1920. A Harlingen cat, adopted by this lady in her loneliness, developed a mammary tumour on the right side and was brought to him for operation. He removed the growth in November, 1921, but it recurred six months later, when it was again removed. The cat lived a year and a half longer, but became so very ill that it had to be destroyed. In April, 1924, Mrs. H. came herself to consult him for a lump in the right breast which she had noticed as early as January. She was operated upon within a few days, but, as in the case of her cat, the tumour recurred and was removed a second time in January, 1925.

I asked Dr. Bosch to find out whether there had been any cancer in his patient's family, or in the houses she had previously inhabited. On May 4, 1925, Dr. Bonne informed me that he had received a letter from Dr. Bosch in which the latter wrote: "My patient (the breast tumour in the house of the cat with a tumour) is now fifty-two years of age. She lived in the province of Groningen till she was forty-seven, and then five years in Harlingen, always in the same house: Noorderhaven 55. She had never any contact with other persons suffering from carcinoma, and there was no history of cancer in her own family. In her present house there has been no cancer during the last twenty-five years so far as known, but there have been cases in neighbouring houses."

On my return to England, a friend informed me that one of his relatives, a lady of about 40, residing at Warley Woods, Birmingham, had been operated upon quite recently for cancer of the breast. She had long cherished a thoroughbred Yorkshire terrier, a bitch 14 years old who had been a very good mouser. This dog had never had puppies, but had suffered much from milk trouble. Hard lumps having been noticed in her mammary glands, she was taken to a veterinary surgeon, who said the disease was not malignant. Later, however, the dog got worse and was brought to another veterinarian who advised that the animal should be destroyed since the disease was cancer and an operation certainly would be followed by recurrence in about two months' time. Soon after the lady suddenly discovered a small lump in her left breast and was operated upon without delay.

PARASITOLOGICAL RESEARCHES.

Because in previous reports I had discussed at some length the part played by certain helminths (*Cysticercus fasciolaris*, *Opisthorchis felineus*, *Schistosoma hæmatobium*, *Oxyuris vermicularis*, *Trichinella spiralis*, *Gongylonema neoplasticum*, &c.) in the ætiology of tumours, it was suggested that, in the course of my epidemiological investigations in the Trentino, I should endeavour to ascertain whether any parasitic worm, fostered by house-vermin during its earlier stages, might not later become a factor in the production of cancer in man, or in domestic animals, harbouring its adult forms.

Certainly, I had averred that there was cogent evidence to show that *Cysticercus fasciolaris* (the

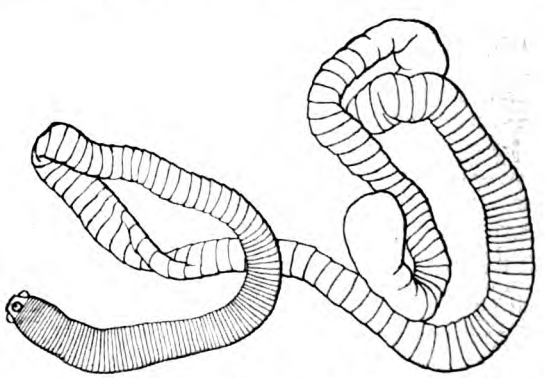


FIG. 17—Larval form of *Hydatigera tæniæformis* Batsch, 1786, usually spoken of as *Cysticercus fasciolaris*.

larval form of *Hydatigera tæniæformis*[1]) might bring about the development of sarcoma in the liver of infested rats, though I had not noticed any kind of growth in about eight hundred rats examined by myself at the London Docks. The majority of these rats had bladder-worms in their livers and in one the liver was so crammed with the strobilate larval forms of the cat's tape-like cestode, that the hepatic sub-

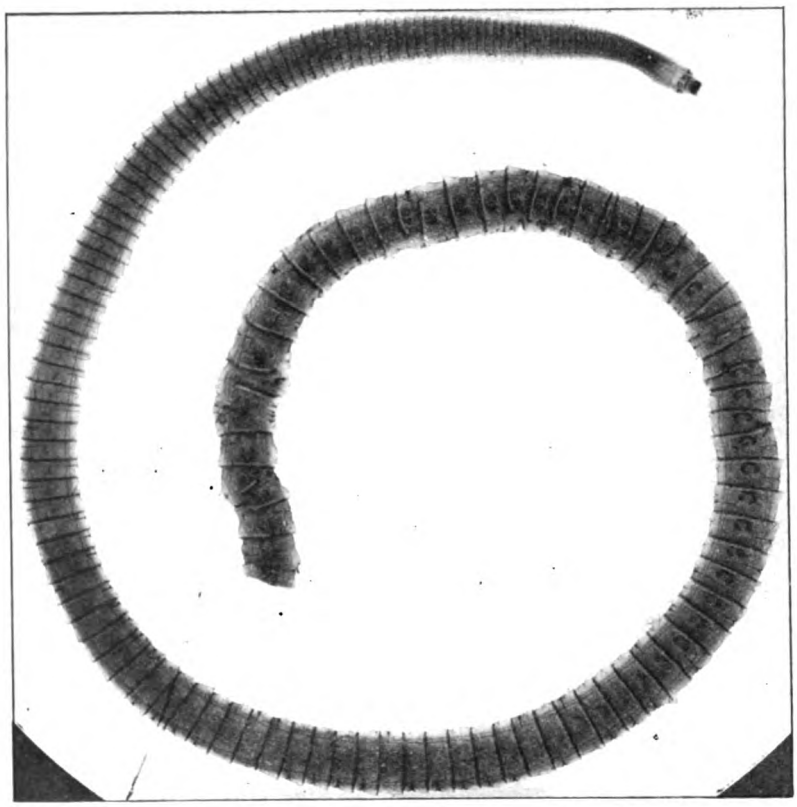


FIG. 18.—*Hydatigera tæniæformis*, Batsch, 1786.

[1] In my first Cancer Report (June, 1924), in mentioning Borrel's work on *Cysticercus fasciolaris* as a cause of hepatic sarcoma in rats and mice, I proposed *Reditænia* as a new genus of Cestoda, with *Tænia tæniæformis* of cats as type species, and I differentiated the larval stage, *Cysticercus fasciolaris*, from other cysticerci under the new name *Strobilocercus*. The generic characters are:—

Tæniidæ, *Tæniinæ:* Rostellum massive, columnar, armed with double row of hooks and resembling an actinia. Suckers prominent, set at base of rostellum and pointing forward and outward. Neck absent; segmentation begins immediately caudad of suckers. Adults in intestine of carnivorous mammals. Larva a "*Strobilocercus*" Sambon, 1924 (i.e., a segmented *cysticercus*, in which the head is introverted within the anterior end whilst the bladder, greatly reduced, is at the caudal end; body more or less segmented; the proglottids occasionally with genital primordia).

Soon after the publication of my paper Professor Henry Ward informed me that he thought I was safe in making the thick-necked tapeworm of the cat a new genus, but that he thought my designation pre-occupied. Later, Professor Stiles wrote that often he had been on the point of recognizing a special genus or subgenus for *Tænia crassicollis*. His tendency, however, was towards the subgenus. He enclosed proof of a paper which he and Miss Orleman were sending to press. In it he says:—

"This newly proposed genus (*Reditænia* Sambon, 1924) is of interest in human medicine, from two points of view, namely, *a* (*b*). As parasites of man:—

"(1) *Tænia infantis* Bacigalupo, 1922 (*Semana méd.*, 302-305, figs. 1-5), has recently been described as a new parasite of man in Argentina. It bears a remarkable resemblance to *T. tæniæformis* of cats, and if it is a valid species it is to be classified in the same genus with the tapeworm of the cat.

"(2) *Tænia crassicollis* Rudolphi, 1810a, is synonymous with *T. tæniæformis*. On account of a folk custom of eating chopped liver of mice in cases of retention of urine, this worm has long been under suspicion as a possible parasite of man (but its occurrence in man is as yet doubtful).

"*b* (*a*). Because of the concurrence of cancer in the liver of rats with the presence of *Cysticercus fasciolaris*.

"Whether, or not, the characters advanced by Sambon will be accepted as of generic value will depend largely upon individual conceptions of taxonymy. Conservatively they might be accepted as of subgeneric rather than of generic value, but admittedly this is a subjective opinion.

"Attention may, however, be invited to the point that if *Tænia tæniæformis* is accepted as representing a genus or a subgenus distinct from *Tænia* (*Tænia*) type *T. solium*, and *Tænia* (*Tæniorhynchus*) type *T. saginata*, the new generic name *Reditænia* falls into synonymy, for it is antedated by two other names, *Megacephalos* and *Hydatigera*, both based upon the same species as genotype.

"*Megacephalos* Goeze, 1782a, 42, was based upon the larval form *Tænia vesicularis fasciolata* (× *Cysticercus fasciolaris*) of the rat. The question arises, however, whether this name is available in nomenclature. The nomenclatorial practices of Goeze, 1782, are so confusing and subject to such subjective interpretation that the senior author of this paper circularized a number of helminthologists about thirty years ago with the proposition that Goeze, 1782, be eliminated from consideration in nomenclature because of the inconsistencies. Several of

stance seemed almost entirely obliterated. But the observations of Regaud, Bridré, Saul, Conseil, McCoy, Woolley, Wherry and others established the association of worm and neoplasm; moreover, the recent and numerous experiments of Bullock and Curtis, who, indirectly, had repeatedly obtained the production of sarcoma in the livers of laboratory rats by feeding them with the eggs of the cat's tapeworm, seemed irrefutable.

Immediately after the lecture which I had the honour of delivering at the Pasteur Institute in Paris, on December 10, 1924, Professor Borrel invited me to go with him to Strasbourg. There he kindly presented me with some of his old sections of cancerous rat-livers showing to perfection the growing of tumours, almost bud-like, out of the fibrous protective tissue which forms the strobilocercus, cyst wall. Figs. 19, 20, 21 and 22 are photographic reproductions of these sections made by Dr. A. Leslie Sheather, M.R.C.V.S. Fig. 19 shows a large spindle-celled sarcoma in a rat's liver and fig. 20 an epithelioma in a rat's kidney, both arising from the encapsulating host-tissues surrounding the early forms of *Hydatigera tæniæformis*. In many other cases the neoplasm has been described as completely enclosing the living bladder-worm and thus resembling a solid gall such as we see on the leaves of the willow enclosing the larva of a Saw-fly (*Nematus*), but not actually produced by it.

Then, again, Professor Fibiger's well-known obser-

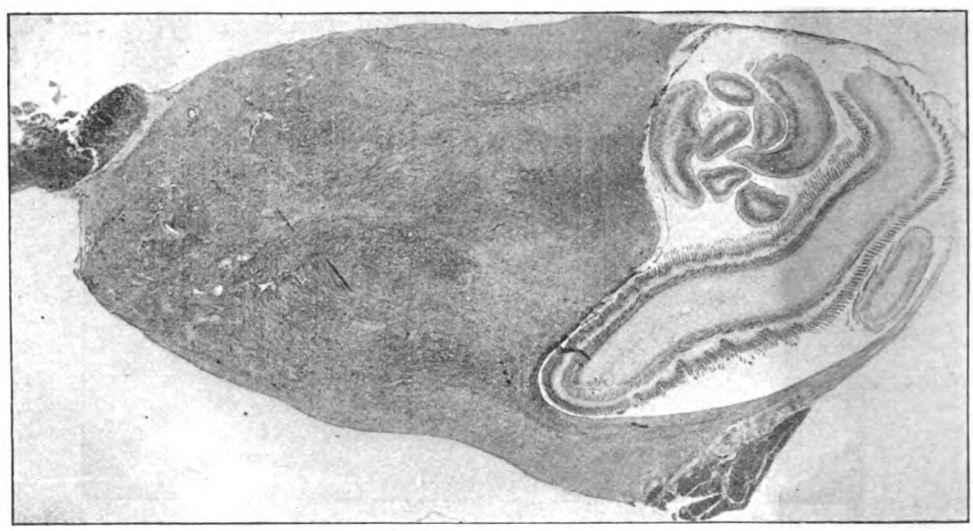


FIG. 19.—Large spindle-celled tumours arising from cyst of *Strobilocercus fasciolaris* in liver of rat.

Goeze's names had however become current and the proposition did not meet with favourable response. Accordingly, he bowed to the view of the majority and accepted Goeze's names. To recognize *Megacephalos*, 1782, at present might produce confusion in other groups, the extent of which cannot be immediately foreseen. The following technical names of the same derivation have been proposed: *Megacephala* Latr., 1802, coleopt.; *Megacephala* Meig., 1824 (supergeneric), dipt.; *Megacephalon* Gray, 1846, aves; *Megacephalus* Fitz., 1843, rept. Partly on basis of the principle that current nomenclature should not be disturbed unless the necessity therefore is clear under the International Code, and partly on the premise that we have grave misgivings as to the availability (under the International Rules) of Goeze's name *Megacephalos*, we are unwilling to assume the responsibility of accepting it.

"*Hydatigera* Lamarck, 1816b, 153-154, was proposed to contain (1) *Cysticercus fasciolaris* of rodents, (2) *C. fistularis* of the horse, and (3) *C. cellulosæ* of man, &c. The first species, *C. fasciolaris*, was later definitely designated as genotype. *Hydatigera* is on a different basis from *Megacephalos* and under Articles 25 and 26 of the International Code this name undoubtedly takes precedence over *Reditænia*.

"The purpose of inviting attention to this point is to prevent if possible the use of the generic name *Reditænia* in medical literature with the certainty in view that it would have to be changed later. If the new taxonomic unit proposed is accepted by authors as of either generic or subgeneric value, the correct name will be *Hydatigera* with *Reditænia* as synonym."

In this Report, as suggested by Professor Stiles and Miss Orleman, whose reasoning I appreciate throughout, I have adopted the name *Hydatigera*, proposed by Lamarck in 1816, but Stiles' view concerning Goeze's names, as he himself states, is not shared by the majority of zoologists. Dr. F. A. Bather, F.R.S., a member of the International Commission on Zoological Nomenclature, whom I have consulted about Stiles' opinion, holds that the names coined by Goeze in 1782 should have currency. He says: "No particular objection being taken to *Megacephalos*, it is therefore admissible. The point is then made that *Megacephalos* may conflict with several other names of the same etymology, but slightly different spelling. If we hold to the purely nomenclatorist attitude that in all and every case the difference of a single letter constitutes a difference of name, then *Megacephalos* must be retained. If we consider that *Megacephalos* should (as I for one hold) have been written *Megacephalus*, then it conflicts with *Megacephalus* Fitzinger. Others might hold (as I do not) that it conflicts with *Megacephala* Latreille. But even so, all these variants are at least twenty years later than *Megacephalos* Goeze. Therefore, on this count also *Megacephalos* must be retained."

Mr. C. Davies Sherborn, Bibliographer to the British Museum (Natural History), also thinks that Goeze's name, *Megacephalos*, was probably intended as a subgeneric name and should be retained as such, or raised to generic rank if opportune.

Dr. H. A. Baylis holds that Goeze's name, if retained, should be retained as originally spelt; others insist on emendation.

Who is right?

"Quot homines, tot sententiæ!"

vations on the gastric carcinoma of rats brought about by the parasitism of the rat-gongylonema (*Gongylonema neoplasticum*) were fully confirmed by experiments similar to those of Bullock and Curtis in the case of the liver sarcoma, viz., by feeding laboratory rats with the large American Cockroach (*Periplaneta americana*), found in the sugar-refineries of Copenhagen, but imported with raw sugar from the West Indies, and harbouring the encysted larval forms of *Gongylonema neoplasticum*.

Other nematode parasites, such as *Trichosomoides crassicauda*, had been incriminated as factors in the production of tumours in rats, while Borrel had long ago described neoplasms of the rat's skin the onset of which appeared to have been incited by a species of *Demodex* peculiar to the rat.

The discovery that at least two rat-tumours—a liver sarcoma and a gastric carcinoma—are usually brought about through the agency of parasitic worms, to wit a cestode and a nematode respectively, was, it seemed to me, a step of considerable oncological importance.

Supported by these facts, the likelihood of the agency of certain helminths and other minor parasites in the production of malignant tumours in animals and man became a subject of the greatest interest and one demanding close investigation. The striking difference noticed in the visceral location of cancer in the inhabitants of different countries found a natural and reasonable explanation in the different and corresponding location of certain helminths peculiar to the inhabitants of such countries, the

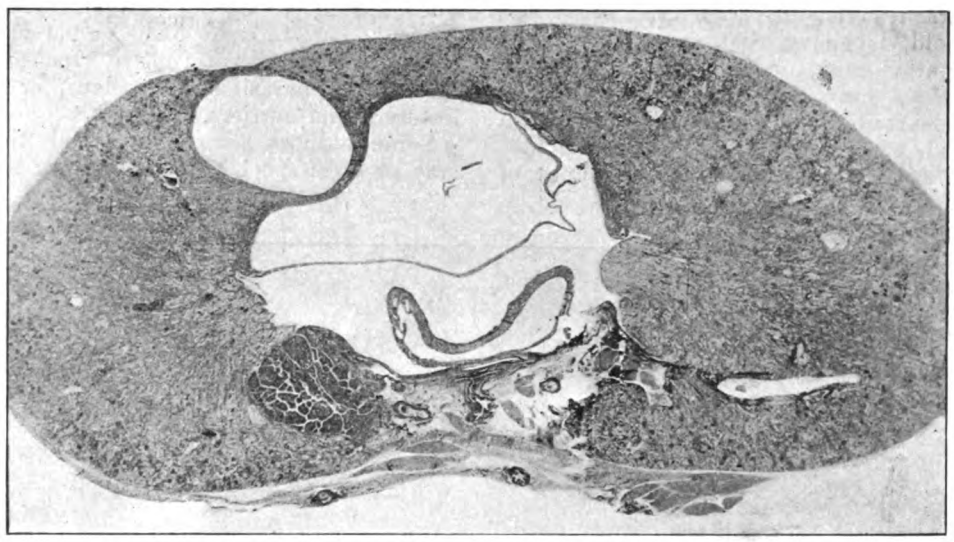


FIG. 20.—Kidney of rat with epithelial tumours arising from multilocular cyst.

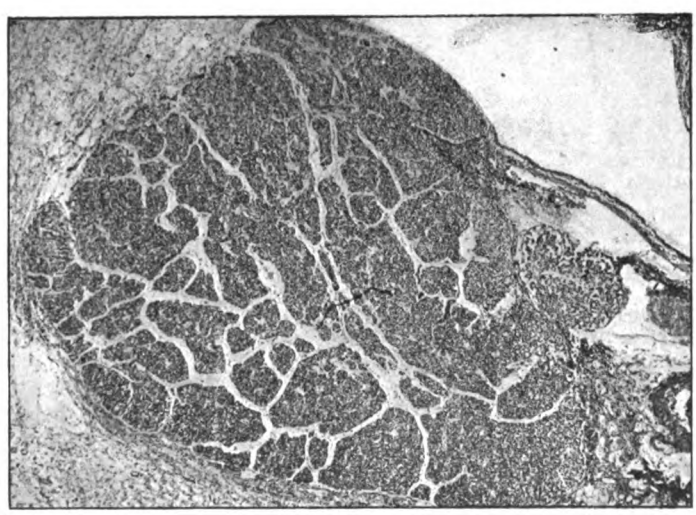


FIG. 21.—Epithelial tumours in rat's kidney.

obvious explanation being supported by actual facts long known. I need but mention the comparatively greater prevalence of cancer of the urinary bladder and rectum in Egypt in the presence of *Schistosoma hæmatobium* and *Schistosoma mansoni* which respectively affect these organs, and the greater prevalence of primary hepatic cancer in China, Malaya and Japan, where *Schistosoma japonicum*, *Clonorchis sinensis*, *Opisthorchis felineus*, and other liver parasites abound.

It is still held, I believe, that repeated or long-continued irritation may, under certain conditions, give rise to the formation of neoplasms. The smoking of a short-stemmed clay pipe is alleged to be a cause of cancer of the lower lip in England, whilst betel-chewing is held responsible for cancer of the cheek in Travancore and Saigon, kangri-burn for cancer of the thigh and abdominal wall in Cashmere.

Against these incriminations are opposed the obsolescence of the clay pipe, the frequent presence of lip-cancer in non-smokers, the rarity of oral cancer in the betel chewers of Tonquin and other countries of the Areca palm, the absence of kangri-cancer in Southern Italy, where the "scaldino," a portable charcoal stove, exactly similar to the Cashmerian kangri, but without any insulating basket-work covering, is very generally used. I readily admit, however, that the irritation associated with peculiar habits may well be a predisposing factor in the production of localized forms of cancer which are restricted to certain peoples and places. The same might be said of "occupational cancer." This being so, surely it is not unreasonable to expect that irritation due to parasitism also should lead to tumour-growth in organs infested by certain helminths and account for the localization of the disease in those particular organs which happen to be the usual habitat of each one of these parasites within its respective geographical area. For, surely, if worms, mites, or other irritant parasites do have any causal relationship to cancer the sooner we know it the better. Then should we be able to control such forms of cancer, as are brought about by parasitism, through the adoption of preventive measures directed against the parasites themselves, or against their fosterers and carriers, if any.

Some authors have conjectured that parasites may produce special growth-inciting secretions, but this is hardly likely, seeing that not one species, but many, belonging to the most sundered groups of parasites, are concerned. Indeed, when several or many individuals of the same species of parasite invade any organ (the liver, for instance, in the case of *Strobilocercus fasciolaris*), they do not all give rise to neoplasms: one or two only do so, if any, rarely more. Besides, in many cases, it is not the parasite itself that produces the neoplasm, but its ova, and these act merely in a passive way like inert foreign bodies which certainly often have been the starting point of cancers. Moreover, the production of cancer is not a constant, inevitable sequel of infestation by the incriminated parasites, but, on the contrary, an infrequent one.

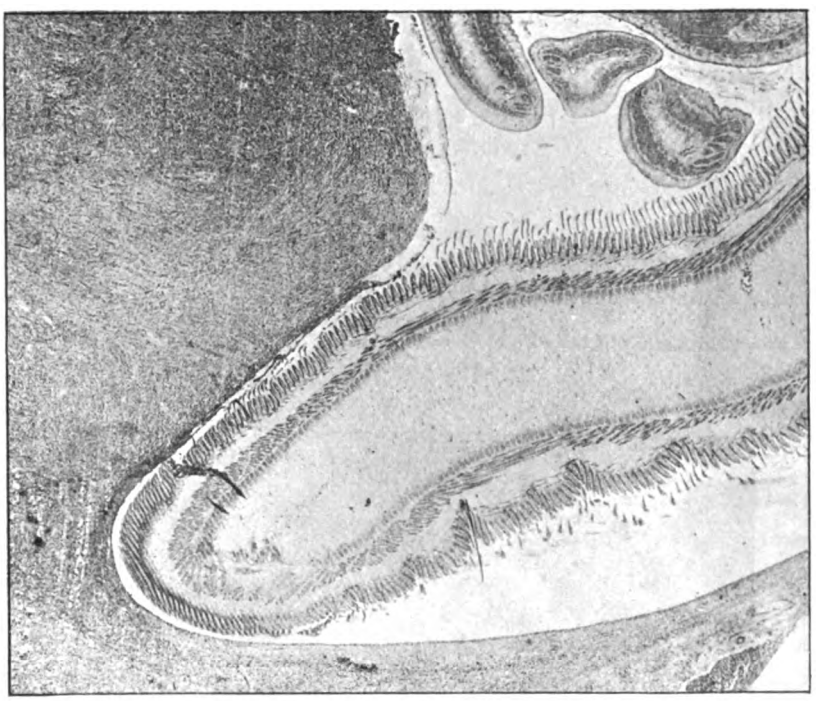


FIG. 22.—Larval form of *Hydatigera tæniæformis* embedded in sarcoma of rat's liver.

GONGYLONEMA.

As stated in previous reports, researches made by Dr. Baylis and myself in Italy during the autumn of 1924, had elicited the fact that *Gongylonema* was present in the cattle, sheep, goats and hogs of the provinces of Bologna, Ravenna and Trento, though with greatly varying prevalence in the different animals examined and in the different districts visited. With regard to man, we knew that *Gongylonema* had been found, not only in several of the States (Arkansas, Florida, Georgia, Louisiana) of the American Union, by Ward, Stiles and Ransom,

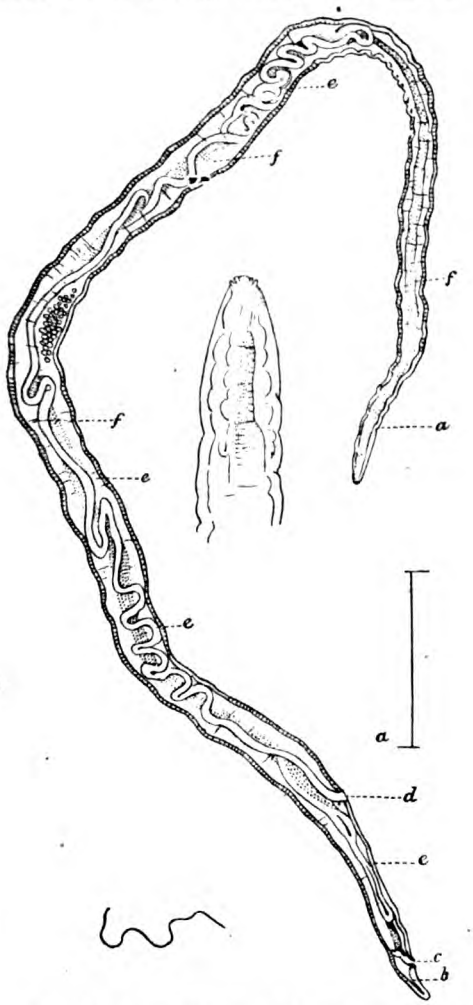


FIG. 23.—Pane's "*Filaria labialis*," a *Gongylonema*, probably *G. pulchrum*. From the original drawing by Paolo Panceri, 1864.

but also in Italy by Alessandrini in a young woman of Saracinesco, near Rome, in 1914, and by Professor C. Pane, of the University of Naples, in a medical student, in 1864. Pane described his specimen under the name of *Filaria labialis*, but a drawing by Panceri enabled me to make the diagnosis of *Gongylonema sp.*, a diagnosis readily accepted by Stiles, Ward and Baylis.

During my visit to Holland I looked for *Gongylonema* and had the good fortune of seeing it at the Amsterdam Municipal Slaughter House. Dr. Bonne had informed Dr. Reeser, Superintendent of the Abattoir, that I desired to look for the presence of *Gongylonema* in Dutch breeds of cattle, sheep and hogs, and when, on April 24, I called by appointment on Dr. Reeser at the superb Amsterdam Abattoir, he told me that Dr. Veenstra had purposely opened up a large number of bovine gullets in the morning and found the required parasite in one of them. This was the first time that *Gongylonema* was looked for and found in the land of the beautiful black and white oxen which are believed to be the direct descendants of the ancient Aurochs. Together with Drs. Reeser, Bonne and Veenstra, I examined many other gullets of cattle, sheep and hogs, but with negative result. Some days later, at the Harlingen and Leeuwarden slaughter-houses, with the aid of the local veterinarians, Dr. Bonne and I examined more than sixty sheep, but the result was again negative. Since May last, Dr. Ferwerda has examined 2,100 more sheep at Harlingen with negative result.

The *Gongylonema* specimens found at the Amsterdam Abattoir were typical of *Gongylonema scutatum* and numbered about twenty in the one œsophagus, including both males and females.

At the Dutch Cancer Institute, I had the pleasure of meeting Dr. W. F. Wassink, who showed me several parasitic nematodes which he had been studying with a view of ascertaining what part they played, if any, in the causation of tumours. Among these worms were *Gongylonema neoplasticum*, *Heterakis isolonche*, *Trichosomoides crassicauda*, *Hepaticola sp.* Dr. Wassink had already published two very interesting papers, one on *Heterakis* and the growths to which it gives rise, the other on *Gongylonema neoplasticum*, detailing his researches and experiments which confirmed and extended Fibiger's work. Dr. Wassink very generously allowed me to take away some of his material in order that I might study it more closely from the parasitological point of view. I was particularly pleased to secure a mouse *Gongylonema*, the only one remaining, I believe, out of several found in six mice caught in a sugar refinery of Amsterdam which was said to be entirely free from rats.

The first *Gongylonema* ever described—the type species of the genus—is *Gongylonema minimum* Molin 1857. It was found by Rudolphi in the house mouse (*Mus musculus*) "circa ventriculum et in hepate" and mentioned in his Synopsis (1819) under the name of *Filaria musculi*, but without either description or figure.

Under the heading "? Filaire de la Souris" Dujardin (1845) states that a mature female specimen of Rudolphi's parasite, sent from Vienna to the Paris Museum, in 1816, measured 21·6 mm. in length by 0·154 mm. in thickness. It presented two lateral membranous alæ in the anterior portion and a tapering but blunt-ended posterior extremity. The elliptical ova measured 45 microns long by half that size in thickness. These characters, he thought, suggested a *Spiroptera*. Only two mice had been found infested out of 1,274 examined.

It was the Italian helminthologist, Dr. Raffaele Molin, who first proposed, in 1857, the genus *Gongylonema* for this parasite, which he described under the name of *Gongylonema minimum*. His description, he tells us, was based on several specimens, male and female, some free, others embedded in a piece of liver, from which they were extricated with difficulty.

Molin's description reads as follows:—

"*Gongylonema minimum*.—Os orbiculare, inerme, Corpus capillare, inerme, flexuosum, breve; extremitas anterior maris attenuata, apice nudo, obtuso, bulbillis parvis, coarctatis; extremitas anterior feminæ attenuata, apice obtuso, bulbillis, magnis, discretis; extremitas caudalis maris inflexa, sensim attenuata, subtus excavata, fovea elliptica, magna, utrique limbis amplis, singulus quatuordecim papillis elevatis, decem ante, quatuor infra aperturam genitalem, vagina penis dipetala; extremitas caudalis feminæ subito attenuata, inflexa; apertura ani prope apicem caudalem; apertura genitalis feminæ in posteriore corporis parte, ab apertura ani remota—Longit mar. 4‴ (8·8 mm.); Longit. fem. 8‴ (17·5 mm.)."

Molin adds that examining the sheath of the penis, at first sight it appears to be a ligulate sheath, but lightly compressing the caudal extremity of the male between two slides the said organ spreads apart into two branches like a forceps and, being released, at once returns to its former shape. The female's long oviduct was full of embryonated eggs.

Speaking of Dujardin's brief description of this nematode, Maurice C. Hall (1916) says: "Dujardin notes a specimen from Vienna as having two cervical alæ. This would suggest that he was not dealing with *Gongylonema*." But in this case there seems to have been some mistake, for the presence of cervical alæ more or less developed and often festooned, is characteristic of *Gongylonema*. On the other hand, the presence of gongylonemas in the liver ("embedded in it") as noted in the Vienna Museum catalogue and also reported by Molin—who says he had considerable difficulty in extricating them—suggests confusion, I think, between *Gongylonema* and a liver-inhabiting Trichinellid since separated from other Trichurinæ by Hall (1916) and given the new generic name of *Hepaticola*.

In Wassink's mouse specimen some of the ova were extruded through a break in the body-wall and oviduct. Thus I had the opportunity of examining them out of the body and singly. They were in different stages of development, some containing fully-formed, coiled-up embryos, others as yet unsegmented. The shells of the fully-matured eggs were elliptical, presenting at each pole a distinct opercular line, but in the earlier stages the polar capsules seemed absent and the embryonic mass enclosed in a membrane protruding at each end of thick egg-shells in the shape of headless barrels.

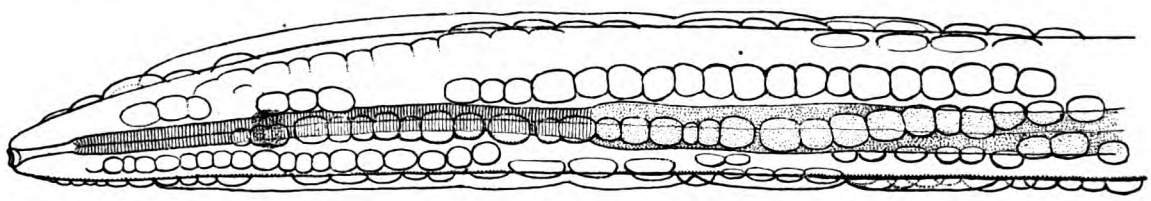


FIG. 24.—Anterior end of *Gongylonema* from mouse.

GONGYLONEMA IN MAN.

In the JOURNAL OF TROPICAL MEDICINE AND HYGIENE (February 2, 1925), in a note following the publication of my Paris lecture on the Epidemiology of Cancer, I stated that Professor Giulio Alessandrini had briefly reported, in 1914, a case of gongylonema infestation in "I. O.," a young woman of Saracinesco, near Rome. Six worms were present, occupying sinuous galleries at the base of the tongue. Alessandrini proposed the name of *Gongylonema subtile* for this parasite, which he considered to be near *Gongylonema pulchrum*, but differing from it in being longer, more slender, and having the studded anterior portion more extended and the eggs smaller and more elongate.

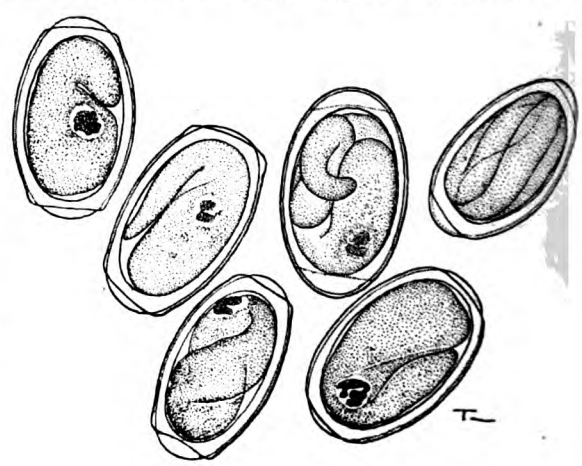


FIG. 25.—Eggs of mouse *Gongylonema*.

Last June, Professor Alessandrini came to London to attend the International Sleeping Sickness Conference and kindly brought us two of the gongylonemas he had been able to obtain from the Sara-

cinesco case. These worms seemed to differ in no appreciable way from specimens of *Gongylonema pulchrum*. Dr. Baylis carefully examined and measured Alessandrini's specimens and came to the conclusion that on morphological grounds they could not be distinguished from those found in cattle, sheep and hogs. These, he considers, belong to one and the same species, a species which, so extended, by right of priority, should be called *Gongylonema pulchrum*.

Personally, on account of slight differences in size (smaller size) and visceral location (more frequent presence in oral cavity and tongue), reported by various authors, I was inclined to consider *Gongylonema pulchrum* apart from *Gongylonema scutatum*, but, after comparatively examining several specimens myself, I do not feel justified in considering it more than a host-race, if that.

The question of specificness often is very difficult to settle. Already in 1892, Professor A. Railliet had pointed out the great similarity between *Gongylonema scutatum* and *Gongylonema pulchrum*, but had cautiously reserved judgment until male specimens should be forthcoming. These were eventually found by Fayet at Tabessa, in Algeria, and sent to Professor Neumann, who, however, retained the two species, remarking that they were "tout à fait voisines," differing only slightly in size.

Slight differences in body size, relative distance between certain parts of the body, acumination of posterior extremity, length of spicules, seem far too slender, far too variable to permit of specific distinction, yet if constant in the same kind of host, they would indicate the establishment of "host races." There can be no doubt that in parasites which have a wide zoological distribution, and especially in those whose life-cycle is spent in two alternating hosts—a vertebrate and an invertebrate brought into close association by peculiar biological conditions—the host environment may be more or less favourable and may determine certain adaptive modifications of size and shape in the parasite, or a change in its visceral location, just as variable surrounding conditions may cause colour and other variations, or a change of station, in free-living species of wide geographical distribution.

In a paper on "The Hæmogregarines of Snakes," published in the *Transactions of the Pathological Society of London*, in 1907, I suggested for parasites the recognition of "host-varieties" or "host-races" corresponding to the so-called "geographical races" of free-living animals. When adaptation, to a new environment in the case of free-living animals, or to a new host in the case of parasites, becomes marked and constant, then the differentiation acquires specific value, but the recognition of "race" has many advantages; it avoids a bewildering multiplicity of names and manifests the zoological distribution of the parasite, a matter of no little importance to the sanitarian in preventive work.

Often I had found considerable difficulty in writing up differential descriptions of certain hæmogregarines, leucocytozoa and other blood protozoa obtained from closely allied host-species, yet in certain cases I was fully convinced of their specificness. My studies had taught me that hæmogregarines differ specifically in different host-species when the latter belong to different zoogeographical regions, and this specificness is supported by the far more easily determinable specific differences present in the several metazoan parasites concomitantly infesting these same host species. On the other hand, certain species of hæmogregarines, like certain species of metazoan parasites, may be found in a variety of hosts belonging not only to closely-related species, but also to different genera, or even families, provided the latter inhabit the same zoological region and are attacked promiscuously by the same species of blood-sucking ectoparasites.

When I went to Italy last summer, I determined to go to Rome, visit Professor Alessandrini and, through him, get in touch with "I. O.," the Saracinesco case, in order to endeavour to find out where and how she had become infested. Unfortunately, when I reached Rome, on July 28, I was told that Professor Alessandrini had left the day before for his summer holidays. However, I found Dr. Alessandro Carega, the physician who had examined Signorina I. O., extracted two of her worms, and given the latter to the Roman parasitologist for determination. Then, through the report of a fatal accident to a man of the same family, who had been crushed by a motor car, whilst employed at the Costanzi Theatre, I was able to trace, after many peregrinations, the *Gongylonema* patient herself.

Whilst in London, Professor Alessandrini had given me a history of the case which I published in the JOURNAL OF TROPICAL MEDICINE AND HYGIENE, September 1, 1925. Here is the more complete account which Dr. Carega gave me from his case book:—

"In 1912, a young woman of Saracinesco—Irene Ottaviani—came to my surgery to consult me about a small worm which she said she had drawn out of the mucous membrane of her mouth and brought for me to see, rolled up in a scrap of paper. The said worm, dried up and shrivelled, could not possibly be recognized, and I thought I had before me one of those strange cases of hysterical simulation (as of women who pretended they had vomited beetles, toads, lizards or snakes) so frequently described by the gullible physicians of the seventeenth and eighteenth centuries. But the patient insisted on the truth of her statement and told me that some months previously, whilst residing at Tivoli, she had extracted a similar worm by scraping with her nails a tiny prurient nodule which from time to time formed on the floor of her mouth, beneath the tongue. Yet, finding no alteration whatever in her oral mucosa, I asked her to return at the first reappearance of the nodules she had described. After a few days she returned, stating that a new nodule had formed, and at once I proceeded to make a careful examination.

"*Clinical Examination.*—Irene Ottaviani is seventeen years of age, unmarried. Her father died of some acute illness the nature of which she does not remember, her mother succumbed quite recently to uterine carcinoma which had recurred after operation. The patient herself has been always well. She was born at Saracinesco, on May 14, 1895, and lived there until five years old, then at Sambuci up to the age of thirteen or fourteen. During the last few years she has lived alternately at Saracinesco and Sambuci and, within the last eight months, at Tivoli. She is a healthy young woman of robust constitution; all her organs and systems appear to be in sound condition.

"The examination of her mouth reveals a small, whitish nodule the size and shape of an acne pustule, on the floor of the mouth, on the left side and a little below the frenulum linguæ. Close to this nodule one sees a small, red streak which, examined through a magnifying glass, looks like a small, purplish-red serpentine about 3 cm. long.

"Holding the mucosa stretched by means of a pair of forceps, I incised the white nodule with a lanceolate needle and extracted a small worm which at once coiled itself, snake-like, about the needle. This worm is of whitish colour, about 2 cm. long, cylindrical, rather tough, slender as a horse-hair and actively motile.

"Thinking it might be some rare helminth, I took it to Professor Alessandrini for determination. He said it was probably a new species of *Gongylonema* near *Gongylonema pulchrum* and begged me to let him publish the case. To this I consented willingly, since the chief interest of the case was its parasitological curiosity."

Informing Dr. Carega that I intended to visit the various places where his patient had resided, in order to find out, if possible, where and how she had contracted her gongylonema infestation, I said that I had but one day—the following—which I could devote to this object. I proposed that he, Signorina Ottaviani and her married sister should go with Dr. Pan and myself to Tivoli, Sambuci and Saracinesco. Though very busy that day and the next, Dr. Carega kindly put off all else and decided to go with me, "because," he said, "detective work in medicine is a somewhat novel idea."

So, at six o'clock in the morning of September 1, we packed ourselves in a Fiat car and left Rome by the Porta Maggiore. At this gate, originally an archway of the Claudian aqueduct, no less than ten conduited waters meet and, of these, three came from the region we were about to visit. We crossed the desolate, fever-reeking Campagna studded with the triumphal arches of ancient aqueducts and with the ruins of villas and tombs of a mighty race. Few monuments are so impressive as those Roman brick-work structures carrying rivers on their backs for hundreds of miles. But, even more important and wonderful is that vast, unseen network of endless subterranean canals and reservoirs which already in pre-Roman times drained Saturn's land and made it healthy.

I was still musing over the unrivalled sanitation of the ancients, when we passed the ruins of Hadrian's villa and began to ascend the hill on which Tivoli proudly holds out its graceful Sibylline temple over the roaring falls of the Anio. The road winds through an olive wood, a strange assemblage of gnarled, split trunks bearing crowns of grey-green foliage, then leads into "Tibur superbum," the resort of Emperors, noblemen and poets, sung by Horace and Catullus; now a squalid little town. Here Irene Ottaviani resided for about one year, in a large building of the Via del Trevio. Here, after eight months, she had noticed the presence of strange thread-worms beneath her tongue.

From Tivoli we drove to Sambuci, passing through land far more fertile than that of the Campagna. The Sabine and Tiburtine hills rose before us bare and wild and we reached the Fiumicino, or Rio Sambuci. Here, close to an old convent, which for six years had been the patient's home, we found mules awaiting us with pads to ride upon and halters instead of bridles.

After a pause to instruct people to collect house- and stable-vermin against our return, we bestrode our sure-footed mounts and began the climb. The narrow mule-path crept along the brink of deep ravines and, of course, our mules chose the very edge of the precipice. So, we ascended, clinging to the mountain sides, until we reached the little village with its old Saracenic fort looking like a part of the stony mass on which it is built.

We were entertained at the quaint "albergo," kept by Irene's eldest sister, and enjoyed a glorious view from the inn's balcony. Before us stood the Tiburtine and Cornicolanian mountains, between them roared the Anio, beyond lay the open Campagna with the river rushing through it the sooner to reach Rome, faintly looming in the distance. The old Roman wolf-legend took new meaning: there, at our feet, was the lupine Anio suckling the Eternal City made of its substance—grey-white travertine—hard, compact, imperishable, as anyone can see in Roman structures of all periods, such as the Colosseum and Bernini's colonnade in the Vatican Square.

After luncheon we climbed the narrow stair-like streets of Saracinesco cut out of the mountain limestone, reached Irene's earliest home and the Saracenic fastness, avoiding, on the way, the unwieldy black hogs who infest the village. Then we left, with a cloud of white doves rising and fluttering before our advance. These coral-footed messengers belonged to a castle fronting the heaped-up village and built by one of its daughters who, many years ago, went to Rome, sold flowers, was courted, became travelled and wealthy, yet never forgot her wild mountain home, nor her sandalled, sunburnt sisters, with their laughing faces and bright, intrepid eyes.

On our way back from Saracinesco, at Sambuci, we were met by boys with bottles and boxes full of cockroaches, cellar-beetles, scorpions and other creeping things. With them came

Irene's cousin—Dr. Francesco Scornajenghi—the local health officer, who told us he had practised for over twenty-four years in the district of Sambuci, which comprises the mountain village of Saracinesco. Cancer was common at Sambuci and Saracinesco, but he remembered years without a single case, others with several. In Sambuci the disease affects chiefly the breast and the stomach, in Saracinesco, strangely, the stomach and the lip, but never the breast. During his long practice, he had not seen a single case of mammary cancer in Saracinesco, but epithelioma of the lower lip was common, both in men and women, though the men smoked little and the women never. Black beetles (*Blatta orientalis*), as we were able to notice ourselves, swarmed in almost every house. He told us that Irene's mother had died of cancer of the womb.

We visited the convent where Irene had lived. Originally, it had been a Franciscan monastery, but when the monks were turned out, it became a tenement-house for men, mules, oxen, swine and rats. Now, thoroughly white-washed, it is the retreat of black-robed nuns who school the little children of Sambuci.

At the back of the convent was a large orchard with peach, cherry, fig and walnut trees; beyond, a boulder-strewn hillock crowned with oaks. Here



FIG. 26.—Signorina Ottaviani, Dr. Carega and the writer at Rio Sambuci. (Photo by Dr. Pan.)

Irene used to play, but her toys were mud and pigs. Over a hundred hogs had been penned close to the convent and we saw the "porcareccia," or piggery, where they had wallowed in mud and filth. "Yet, my only amusement," said Irene, "was feeding the swine with acorns, or teasing them: there was nothing else to do."

On the hill grazed a flock of sheep and some silver-grey cows with wide-spreading horns. Lower down, by the Fiumicino, were many oxen, goats and swine. Irene told me that she had drunk of the water of the stream by the bridge where it meanders shallowly among the boulders and is polluted by the droppings of the wading and drinking herds.

At about five in the afternoon, we left Sambuci and whizzed through the wide Campagna inhaling the air of the meadows scented by the fragrance of the good herb mint.

I asked the patient what she experienced whilst the worms lodged in her mouth. "I felt," she said, "a gentle pulling, a slight tickling or formication (formicolio) caused by something like hairs, or very fine threads, which I could not see, but felt distinctly within the lining of my mouth. I endeavoured to grasp these living threads, but, invariably, they slipped from between my fingers. I managed to hold them, at times, by means of a handkerchief, but though I battled long I could not draw them out. At length I succeeded, and the first two worms I threw away, well pleased to be rid of them."

In the evening, Dr. Carega, Dr. Pan and I met on the Pincio, at the Casina Valadier, to discuss our day's work. Rome—Eternal Rome—lay at our feet stretched out like a prayer carpet, whilst the great, soaring dome of St. Peter stood silhouetted against the flaming sky.

Signorina Ottaviani had told us that the first worm was noticed by her at Tivoli on August 1 of 1912, after a residence of about eight months; the second at Saracinesco on October 2, 1912; the third, again at Tivoli, on November 3 of the same year; the fourth also at Tivoli a few days later and the fifth and sixth in Rome, on April 5 and July 14 of the following year. Considering time only, infection might have taken place in Tivoli, but this was unlikely, because in Tivoli she had inhabited a large, clean, well-built house in the very middle of the town, and her life there had been one of indoor work exclusively. At Sambuci and Saracinesco, on the contrary, she had lived a rural life, nearly always in the open and in constant touch with all kind of animals, such as mules, oxen, sheep, goats and especially hogs. Both in Sambuci and Saracinesco one cannot take a step in any direction without meeting swine; they wallow at the very doors of houses, go in and out of rooms. The streets belong to them; they seem to be the masters and so have been since, and long before, the days of Varo. In Saracinesco, whilst Dr. Carega complacently scratched the ear of one of these portly creatures, a white sow, which seemed eager to make our acquaintance, I asked the innkeeper how they could tolerate such gross, unclean, unshapely beasts about them. "A few minutes ago," retorted he, "you told me our hams were the best you had ever tasted!"

The worms extracted from Irene's mouth and brought to London by Professor Alessandrini could not be distinguished from *Gongylonema pulchrum* of swine and, during our trip up the valley of the Aniene, swine had been much in evidence, both at Sambuci and Saracinesco, but especially at Sambuci. So, no doubt, Professor Henry Ward was right when, determining the first *Gongylonema* found in man in America, he told us that, probably, it was *Gongylonema pulchrum*, though the specimen sent him for determination was a single immature female.

A similar diagnosis was made by Alessandrini,

who had the good fortune of obtaining three mature female worms, but was induced by the importance of the discovery of *Gongylonema* in man to create a new species.

From these and other considerations, such as the size of the worms and their presence within the oral cavity and about the tongue, a location not infrequent in swine, I hold that the gongylonema found in man in Europe and America is *Gongylonema pulchrum* Molin 1857, and that the names *G. labialis* (Pane 1864), *G. subtile* Alessandrini 1914, and *G. hominis* Stiles 1921, are but synonyms of *G. pulchrum*. Further, like Baylis, I am inclined to add to these synonyms also *G. ransomi* Chapin 1922, especially as true swine (*Suidæ*) are confined to the old world, and domestic pigs were not introduced into America before the seventeenth century. The "Razorback," now found almost exclusively in the South, is the oldest new-world porker, a degenerate descendant of the pigs that were brought to America by the earliest white settlers.

Gongylonema in Villa Lagarina.

On reaching Villa Lagarina, we at once started looking for *Gongylonema* in all those animals—mammals and insects—which we knew might harbour it in one or other of its developmental stages. We looked for the adult forms in rats, mice, sheep, goats, hogs and oxen, and for the larval forms in cockroaches, cellar-beetles, meal-worm beetles, and dung-beetles.

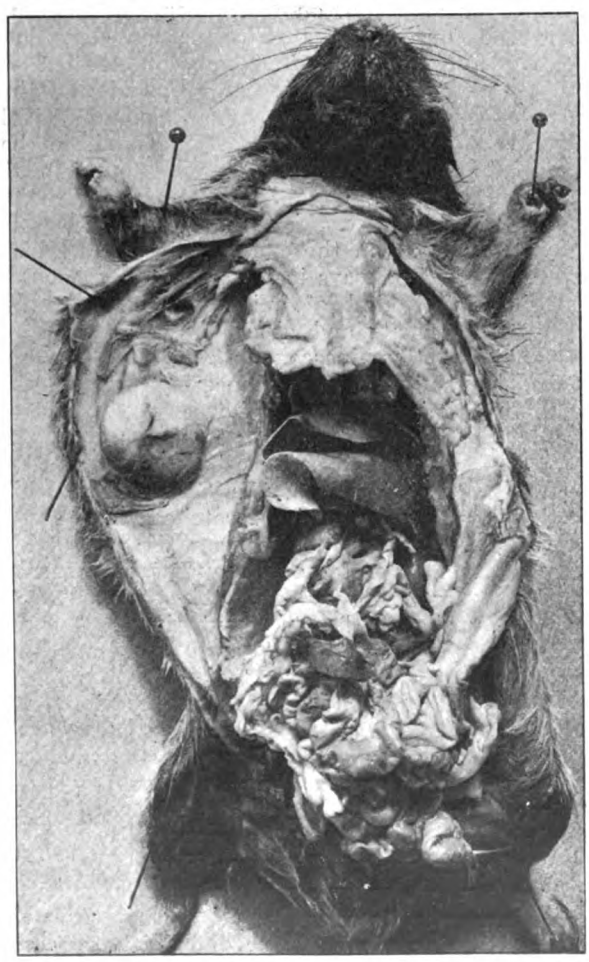


Fig. 27.—Villa Lagarina rat with fibro-adenoma of mammary gland and malignant papillomatous growth in stomach.

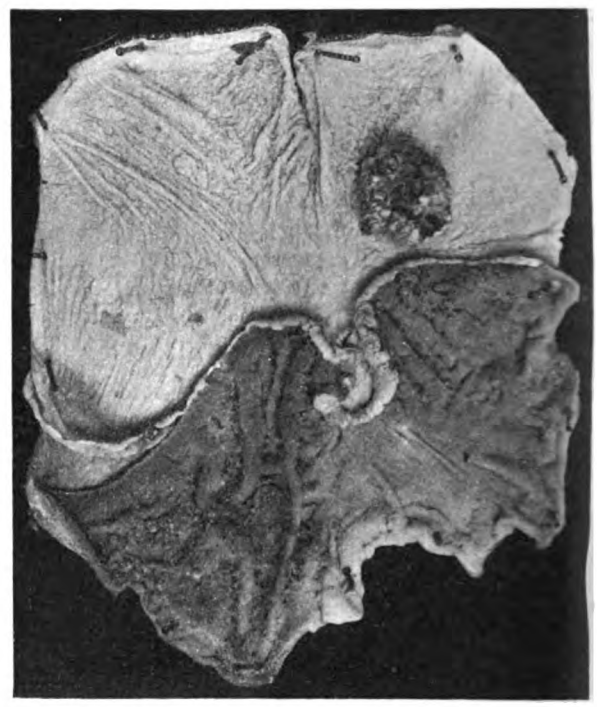


Fig. 28.—Carcinoma in cardiac portion of rat's stomach with *Hepaticola gastrica* embedded in growth.

With the aid of Dr. Scrinzi and the local chemist, we made known that we offered to pay a reward for each rat and mouse captured alive or freshly killed. We organized a rat-catching squad of boys, bought and distributed numerous traps of various types and made arrangements with the chemist who kindly undertook to pay for us the premium, receive the dead rodents, slit them open and place them in a formaldehyde solution to await dissection and examination. Thus we thought we had started a formidable crusade against the Lagarina rats and mice, but the first week's output was so disappointing that we decided to increase the reward to ten times the original figure. Yet the higher premium brought no better results. The people told us it was a bad season for rat-catching. Most of the rats and mice were out in the fields, where they could find plenty of food, and those who remained behind were exceedingly wary and shunned traps.

Then I placed a number of steel-traps myself in the most likely places and with every precaution, following the instructions so clearly set forth in the book on "Rats and How to Destroy Them," recently published by our late, much regretted, associate, Mr. Mark Hovell. I was greatly helped in this work by a young, intelligent local butcher, Signor Claudio Agostini, who took the keenest interest in our inves-

tigations. Consequently, a dozen rats were soon caught; all belonged to the same species, *Rattus norvegicus*, and one of them, an aged female, trapped in the neighbourhood of a pigsty, proved of the greatest interest, being affected by two different neoplasms: a mammary tumour on the right side, above the third nipple and a large papillomatous growth in the cardiac portion of the stomach. The latter neoplasm seemed to have grown out of worm-galleries excavated in the gastric pavimentous epithelium by a Trichurine worm of the genus *Hepaticola*. Dr. Bonne undertook the study of these neoplasms and his sections show that the mammary growth was a benign fibro-adenoma, whilst the gastric tumour was a true cancer, an epithelioma, with a worm or worms involved in its fabric. Sir Lenthal



FIG. 29.—Œsophagus of heifer from Villa Lagarina with numerous *gongylonemas* beneath epithelium.

Wheatle, who has examined Dr. Bonne's slides, fully agrees with his findings and statements.

We captured and examined about ninety rats in Villa Lagarina, twice finding mammary tumours, but once only carcinoma. In no case did we find any *Gongylonema*, though a majority of the rats were infested with other nematodes such as *Trichosomoides* in the urinary bladder and *Hepaticola* in the cardiac portion of the stomach. On the other hand, all the local cattle, slaughtered at Villa Lagarina, presented more or less numerous gongylonemas bedded in the œsophageal epithelium. The first gongylonema seen in a Lagarina bovine was found by the butcher's sister, a girl of sixteen, to whom I had shown a photograph of a sheep's gullet full of these worms sheltered in their sinuous galleries. After this her brother Claudio scrupulously examined every œsophagus and constantly furnished us with material for our experiments.

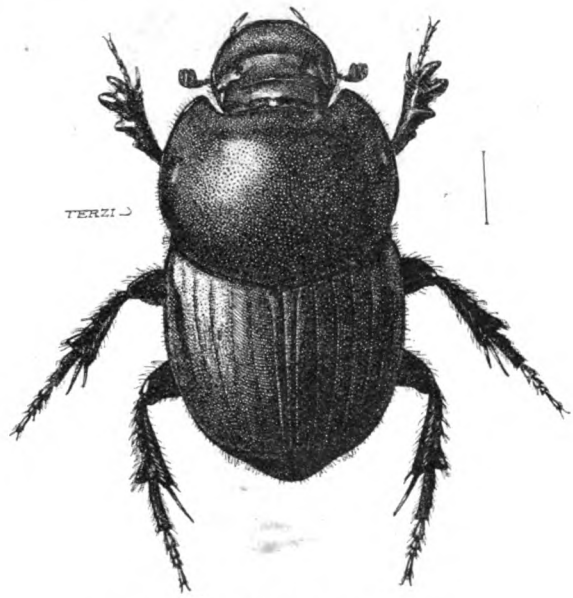


FIG. 30.—*Onthophagus taurus*. ♀.

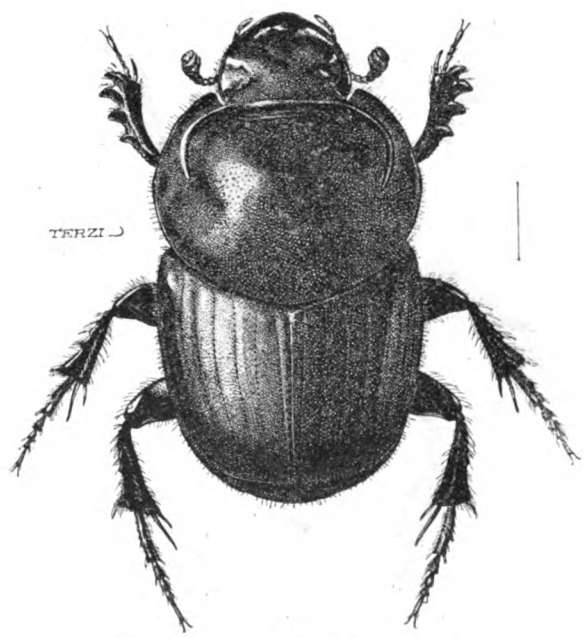


FIG. 31.—*Onthophagus taurus*. ♂.

Notwithstanding the absence of gongylonemas in the mice and rats we were able to capture in Villa Lagarina, we carefully examined cockroaches (*Blatta orientalis* and *Blattella germanica*), cellar-beetles (*Blaps lethifera*), and meal-worm beetles (*Tenebrio*

molitor and *T. obscurus*), but invariably with negative results.

On the other hand, the examination of dung-chafers proved that these lamellicorn beetles did harbour the larval stages of the species of gongylonema found in the local cattle. Several kinds of dung-beetles were collected in Villa Lagarina and its immediate neighbourhood and determined by Mr. Blair; they were the following: *Onthophagus taurus*, *O. opacicollis*, *O. furcatus*, *O. muchicornis*, *O. lemur*, *O. ovatus*; *Aphodius subterraneus*, *A. fimetarius*, *A. hæmorrhoidalis*, *A. erraticus*; *Caccobius schreberi*, *Gymnopleurus strumi*, *Oniticellus fulvus*, *Copris lunaris*, and *Geotrupes mutator*. Of these, only four were found to be harbouring the encysted larval forms of *Gongylonema*, they were: *Onthophagus taurus*, *Oniticellus fulvus*, *Caccobius schreberi*, and *Aphodius hæmorrhoidalis*, all of which are new to science as hosts of *Gongylonema*. Indeed, hitherto, no one seems to have studied the intermediary hosts of the cattle gongylonema (*Gongylonema scutatum*) in Europe.

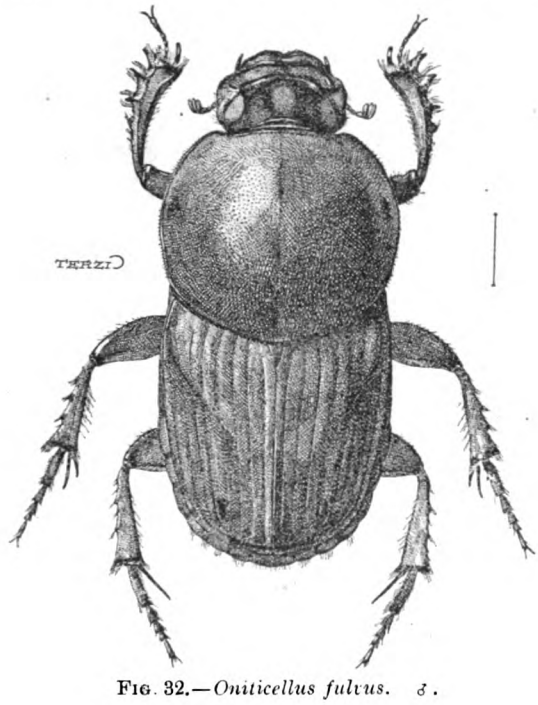


FIG. 32.—*Oniticellus fulvus*. ♂.

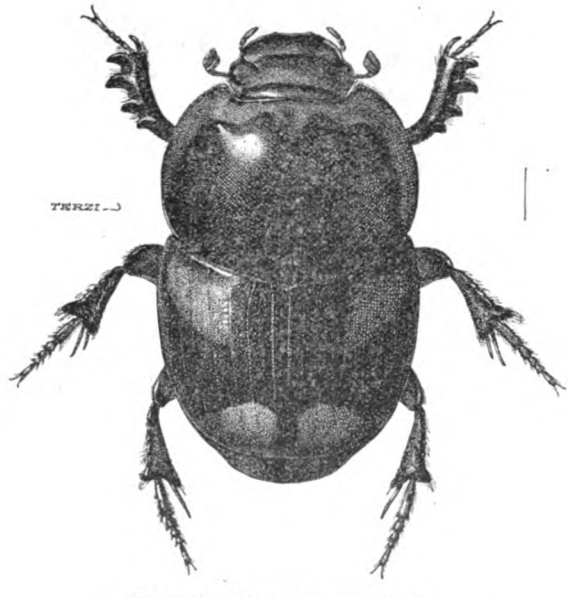


FIG. 33.—*Caccobius schreberi*.

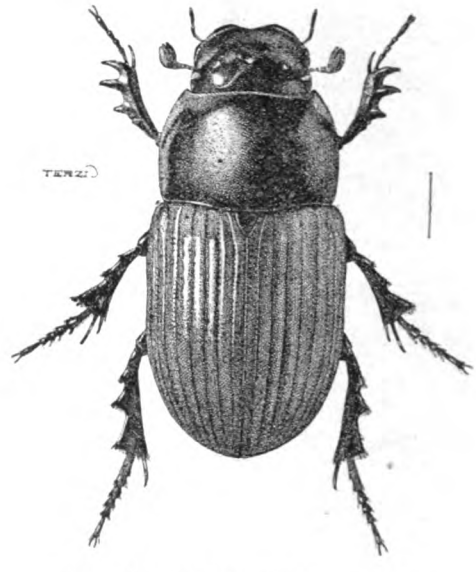


FIG. 34.—*Aphodius fimetarius*. ♀.

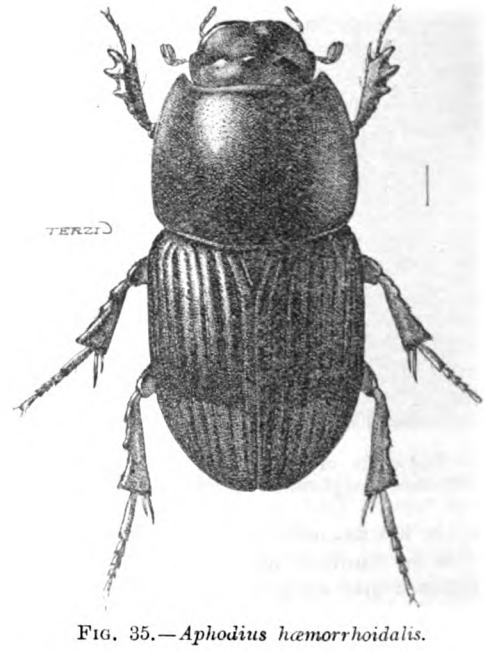


FIG. 35.—*Aphodius hæmorrhoidalis*.

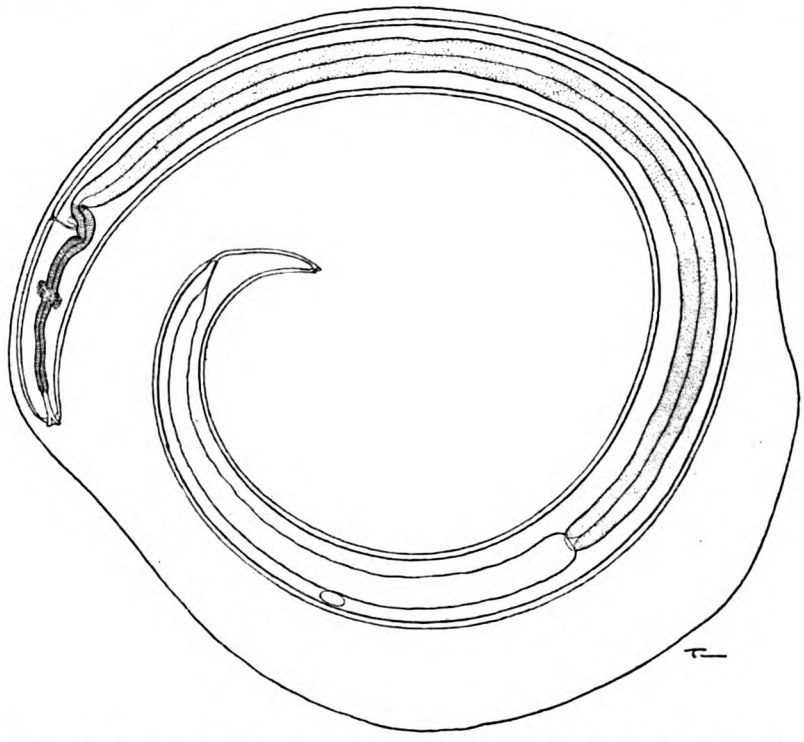


FIG. 36.—Encapsuled *Gongylonema* larva (third stage) from *Onthophagus taurus*. (× about 110.)

The dung-chafers were collected by Drs. Baylis and Pan, Mr. Blair and myself in the droppings of cattle in various places where cows used to be taken out to graze. One of the more convenient places was behind the church, an area of waste land through which ran, or rather trickled, a small brook. Another good place was the strip of communal land

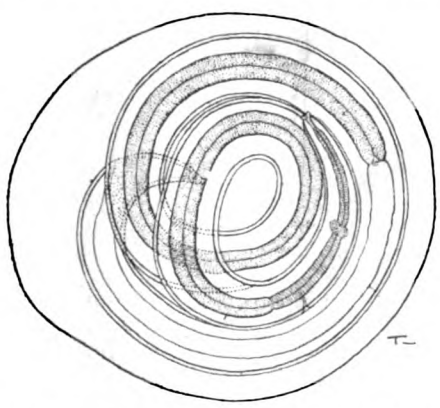


FIG. 37.—Encapsuled *Gongylonema* larva (third stage) from *Onthophagus taurus*. (× about 100.)

along the left bank of the river Adige. Pats of cow-dung, in the open, usually swarmed with dung-beetles, of one or more kinds, and with the larvæ of various kinds of flies. In stables, dung-chafers were never found. Therefore, it is obvious that the infestation of oxen must take place in the open and that the cattle must necessarily swallow, possibly

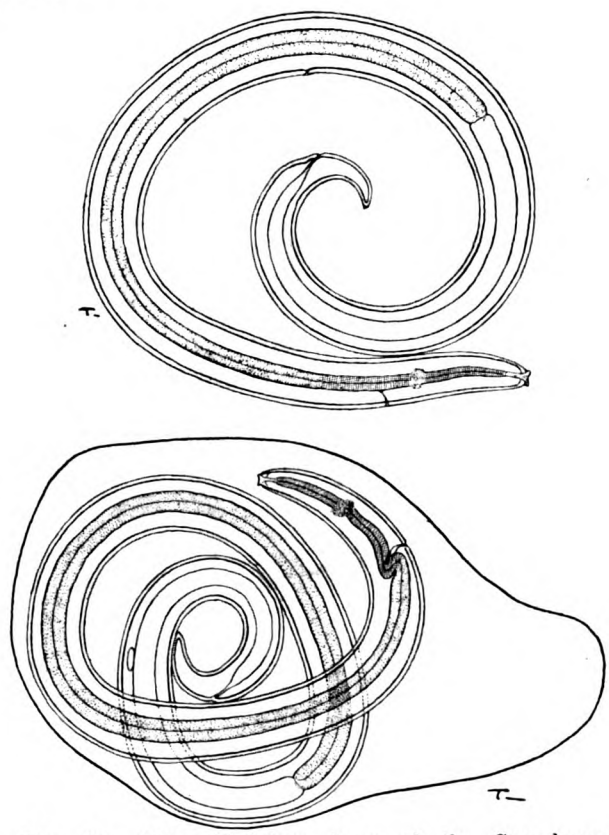


FIG. 38. — Two third-stage larvæ of the *Gongylonema* of cattle, from an experimentally-infected *Blattella*. (× about 100.) One larva is still enclosed in its capsule, the other has been liberated.

with the grass, gongylonema-infested dung-chafers who, in turn, become infested in excrement containing the eggs of the worm. It is possible, however, that larvæ of the third stage may be taken up by cattle, or man, in water, having escaped from crushed insects trodden under hoof or drowned in shallow water. Indeed, fully developed larvæ may leave their cysts and live in water for days. It was probably by drinking at the Fiumicino fords that Signorina Ottaviani contracted her infection. One day, frightened by a savage sheep-dog, she drank deeply of the muddy water.

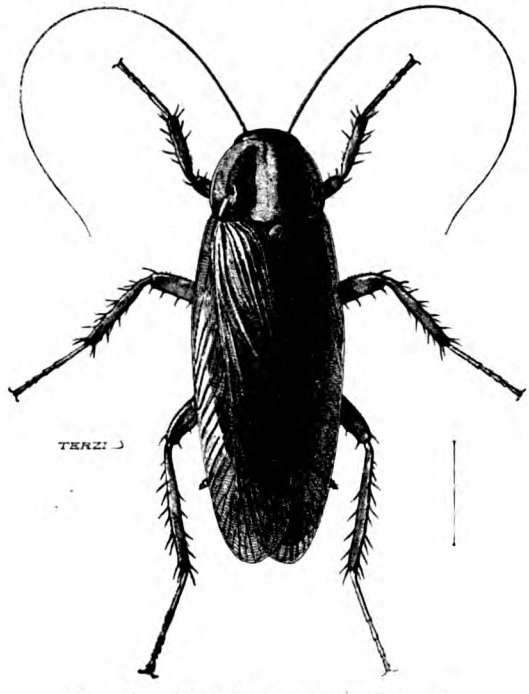


FIG. 39.—*Blattella germanica* (L.). ♀.

Several experiments were made to ascertain whether household insects could foster the larval forms of *Gongylonema scutatum* and whether the larvæ of the cattle form, artificially reared in these insects, or naturally fostered in their usual alternative hosts—the dung-chafers—could continue their development and reach full maturity in rats. These experiments proved successful and of great interest. In the first place, the two available kinds of cockroaches: *Blatta orientalis* and *Blattella germanica* were fed on gongylonema ova taken from worms found in the gullets of sheep and oxen, with the surprising result that while the German cockroach (*Blattella germanica*) was easily infected, the larger and darker Oriental cockroach (*Blatta orientalis*) invariably proved refractory.

Then several rats were fed on dung-beetles collected at random, of which probably only four or five per cent. were harbouring gongylonema larvæ. Others were fed on the smaller cockroach (*Blattella germanica*) artificially infected and probably always

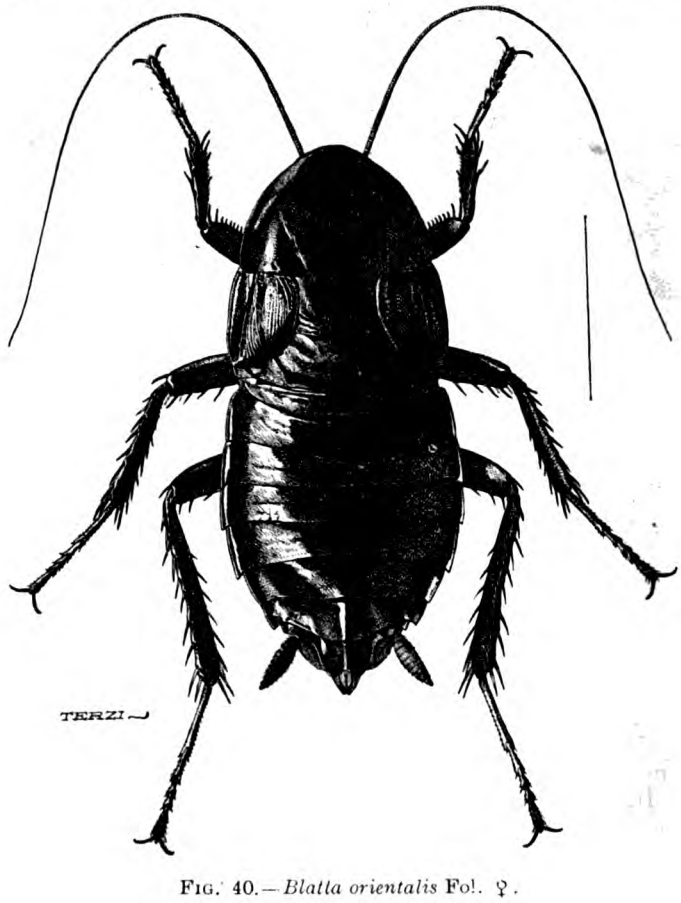


FIG. 40.—*Blatta orientalis* Fol. ♀.

containing many encysted larvæ at the ultimate stage of development. Two of our London laboratory rats, fed on gongylonema larvæ taken from dissected dung-beetles (*Onthophagus taurus, Caccobius schreberi*) and cockroaches (*Blattella germanica*) proved to be infected, and in both cases the recovered worms—a single immature gongylonema in each case—were found, not in the cardiac portion of the host's stomach, as is usually the case with rats naturally or artificially infested with the rat gongylonema (*Gongylonema neoplasticum*), but in the œsophagus, which is just as constantly the natural habitat of cattle and sheep gongylonemas within their definitive hosts. However, too much importance must not be given to this location, because the rat gongylonema may also affect the œsophagus and tongue in naturally infected rats and frequently the œsophagus in laboratory infected rabbits and guinea-pigs. These experiments have been fully detailed in a paper by Dr. Baylis, who, assisted by Dr. Pan and my daughter, Miss Juliet Sambon, carried them out in Trento under the most trying conditions, in an improvised laboratory—at times a veritable furnace.

If the gongylonema found in cattle be the same as that infesting swine, then, as suggested by Dr. Baylis, *Gongylonema pulchrum* Molin 1857 is the correct name for it and *Gongylonema scutatum* (Mueller 1869) necessarily falls into synonymy. Likewise, if rat and mouse do harbour the same species of gongylonema, as I am inclined to believe, then the rat and mouse gongylonema should retain the name *Gongylonema minimum* given it by Molin in 1857, when he first described it and made it the type species of his new genus of Spiruroid worms. This being so, the names *Gongylonema musculi* (Rudolphi 1819), Neumann 1894 and *Gongylonema neoplasticum* (Fibiger and Ditlevsen 1914), Ransom and Hall 1916, would fall into synonymy. Rudolphi's name *Filaria musculi* was a nomen nudum and Dujardin's "Filaire de la Souris" a vernacular name, therefore neither has any status whatever in nomenclature. The latinized name proposed by Neumann in 1894 is antedated by Molin's name *Gongylonema minimum* 1857. However, there are difficulties. With regard to the gongylonema of swine, as I have already stated, there are slight differences in size and visceral location which distinguish it to a certain extent from that of cattle, and, with regard to the mouse gongylonema, we should not forget the smaller forms found by Rudolphi in Austrian mice and described independently by Dujardin and by Molin. The recognition of host-races, or subspecies, would overcome these difficulties.

Examination of the gullets of cattle infested with gongylonema often revealed papillomatous growths

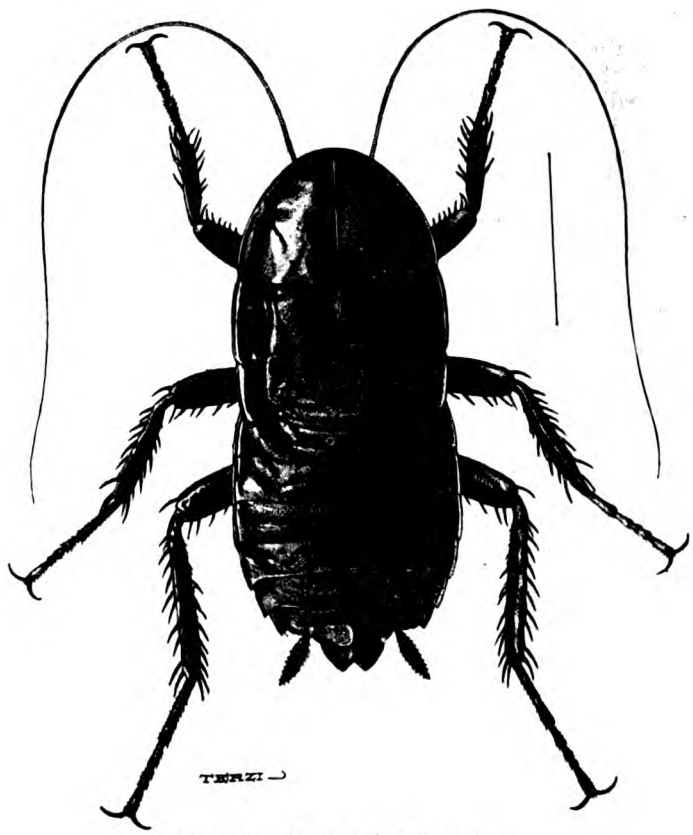


FIG. 41.—*Blatta orientalis* nymph.

in the form of nodular, villous or coralline prominences, but I have no reason to suppose that they were necessarily dependent on the presence of the worm. I have seen identical proliferations of the papillæ and their overlying epithelium in gullets of cattle without gongylonema, and in animals bred in districts apparently free from this parasite.

We did not go to Villa Lagarina solely to study *Gongylonema;* our object was to endeavour to find out, if possible, why cancer showed peculiar limitations in its topographical distribution, why it affected certain houses or groups of houses leaving others, in the vicinity, untouched.

Suspicion having fallen, since long ago, on rats, mice, black-beetles, churchyard-beetles and other vermin infesting old buildings, it was our purpose thoroughly to investigate these house-pests and anything else that might explain well-ascertained restrictions of the disease to particular streets, blocks of houses, or isolated cottages.

As stated, we found no *Gongylonema* in the rats, mice, cockroaches, cellar-beetles and meal-worm beetles of Villa Lagarina, but the number of mice and rats examined was, unfortunately, very meagre. On the other hand, we found *Gongylonema* rampant in the local cattle and dung-beetles. Swine we were unable to examine, because none were being slaughtered at the time, but, from our own researches in neighbouring localities, we know that they do harbour this nematode-parasite when pastured.

The absence or great rarity of *Gongylonema* in household vermin, its restriction to cattle and dung-chafers, whilst necessarily minimising the importance of any part it might play in the incidence of cancer in Villa Lagarina, did not exclude it. Indeed, if Dr. Baylis is right in assuming identity between swine and cattle gongylonemas, the local cattle harboured that very form (*Gongylonema pulchrum*) which has been reported from man both in Europe and America.

Twenty-three cancer cases had been reported in Villa Lagarina since 1884. In none had the neoplasm affected the œsophagus, but three were oral (two palate, one mouth), sixteen gastric and two mammary. In the remaining two the site was not mentioned. Hitherto, *Gongylonema* in man has been found solely about the oral cavity (lips, floor of mouth, tongue).

That *Gongylonema* is capable of favouring cancer growth is fully proved by the numerous observations and experiments of Fibiger, Wassink, Yokogawa and others on the gastric carcinoma of rats brought about both naturally and experimentally by *Gongylonema neoplasticum*. Moreover, whilst carrying out our parasitological researches in Villa Lagarina we had the good fortune of finding a wild rat with a gastric carcinoma associated, not with a *Gongylonema*, but with another nematode, a new species of *Hepaticola*, which, like *Gongylonema*, excavates sinuous galleries and oviposits between the layers of the pavement epithelium of the cardiac portion of the host's stomach. Had *Gongylonema* been there instead of *Hepaticola*, no doubt the same result would have followed. Indeed, when Baylis and I first found *Hepaticola* living in galleries burrowed within the epithelium lining the cardiac portion of rats' stomachs, we both thought and, in our papers of 1924, suggested that probably *Hepaticola* might bring about the formation of neoplasms just like *Gongylonema*. This prevision has now been verified.

An Italian veterinary surgeon, Major S. Raffaelli, has just made an inquiry into the prevalence of *Gongylonema* in food animals slaughtered at the abattoirs of Ravenna, Cesena, Forli, Faenza, Imola and Bologna. He examined 1,970 bovines and found *Gongylonema* in 20 per cent. In sheep, of which he examined 2,800, he found the percentage as high as 70. He examined 330 swine and found *Gongylonema* only once in a hog that had been reared in the open. In fifteen equines he found nothing, whilst in 490 birds (fowls and turkeys) he says he once found *Gongylonema* (? *Gongylonema ingluvicola*) together with "molti *tricocefali* o meglio *tricoblasti*" (? *Capillaria*). These results agree in every way with those previously obtained by Baylis and myself in Bologna and Faenza, in the autumn of 1924.

In the Trentino we found the distribution of *Gongylonema* infestation in cattle to vary considerably in different places. In a general way, we found it to be very prevalent in the Lower Valley of the Adige, infrequent or, maybe, totally absent in the region of the Upper Adige and in the valleys of La Pusteria.

A New Species of Hepaticola.

In October, 1924, Dr. Baylis and I examined a number of rats caught in the yard of the Municipal Slaughter House at Bologna and found their livers literally crammed with the ova of *Hepaticola hepatica*. The egg-masses embedded in the hepatic substance gave the more or less cirrhotic livers the peculiar speckled appearance characteristic of coccidiosis. In the stomachs of these same rats we found nematode-worms lying within sinuous galleries excavated in the stratified squamous epithelium of the cardiac portion. At first sight we thought we had found specimens of the rat gongylonema (*Gongylonema neoplasticum*), but examination of the extricated worms proved that they were not gongylonemas, but Trichurinæ of the genus *Hepaticola*. We noted the unusual location of these worms and, at the time, thought that previous authors had overlooked this location and described them solely from the liver. Here, certainly, they (*Hepaticola hepatica*) are usually found, often dead and disintegrated, within tracts filled with their resistant lemon-shaped ova. The material collected in Bologna (livers and stomachs of infested rats) was brought to London and deposited in the Zoological Department of the British Museum (Natural History).

Last summer, in Villa Lagarina, again we found *Hepaticola* in the stomachs of several of the rats examined, but here the livers of the infested ani-

mals were all normal and entirely free from *Hepaticola* eggs. This fact was striking and instructive. Remembering my observations on the two schistosomes (*Schistosoma hæmatobium* and *S. mansoni*), which, frequently together, affect man in Egypt, I felt certain that in the case of *Hepaticola* also we were confronted by a similar duality of species, each one affecting its own particular habitat.

Obviously, the whip-worm, *Trichocephalus hepaticus*, first described by T. L. Bancroft, of Brisbane, New South Wales, in 1893, and given generic rank, under the name of *Hepaticola*, by Hall in 1916, was not present in the Villa Lagarina rats examined by us, but was found in the Bologna rats together with another, hitherto undescribed, gastric species again

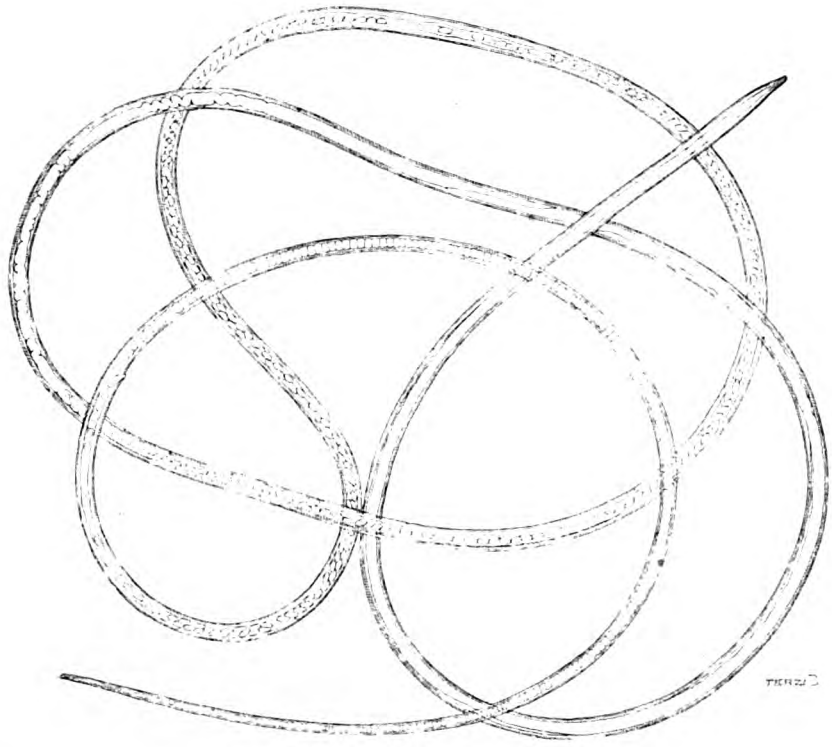


FIG. 42.—*Hepaticola gastrica* (original).

found, but this time alone, in the rats of Villa Lagarina. I believe I shocked my colleagues when I informed them, somewhat dogmatically, that we had before us a new species of *Hepaticola*, differing biologically, and no doubt morphologically also, in body and eggs, but my excuse is that I was fully convinced of the fact and needed no closer scrutiny or exact measurements to affirm it. Indeed when, on his return to London, Dr. Baylis was able to compare the *Hepaticola* eggs laid within the worm-galleries in the gastric epithelium of the Villa Lagarina rats with those taken from the livers of the Bologna rats in his keeping, he recognized the correctness of the assertion. His recent paper on the subject (JOURNAL OF TROPICAL MEDICINE, August 1) gives a description of the new species and details the differences found between the ova of *Hepaticola hepatica*, with their radially striated outer shell, and those of the new species which, owing to its visceral location, has suggested the correlate name of *Hepaticola gastrica*.

Hepaticola gastrica is the parasite we found in the Villa Lagarina rat presenting a gastric carcinoma. In this case, the worms were found not only in galleries between the layers of pavement epithelium which line the cardiac portion of the rat's stomach —some of them at the very base of the papillomatous tumour—but, as Dr. Bonne's sections clearly show, in the very growth itself, suggesting that they, their eggs and galleries, had been incorporated in the neoplasm the growth of which they may have incited. Maybe, the worms had actually sown those specific organisms which had produced, first the papillomatous growth, then, later, its conversion into a veritable cancer by a process of metabiosis, such as is witnessed in the ripening of certain soft cheeses in which successive micro-organisms follow and displace one another, one species being necessarily dependent upon the action of another.

The latter view is confirmed by the researches of Wassink in Holland, who showed me evidence of *Hepaticola* associated with tumour formation in the stomach of Amsterdam rats, and of Beatti, in Buenos Aires, who, on three occasions, found tumours (papilloma, sarcoma and epithelioma) in three different rats harbouring a gastric hepaticola

which, tentatively, he mentioned under the name of *Hepaticola hepatica*, but which no doubt must have been our *Hepaticola gastrica*.

These observations made by us in Italy, by Wassink in Holland, and by Beatti in the Argentine, show that, under suitable conditions, *Hepaticola gastrica*, like *Gongylonema neoplasticum*, may favour, or even incite, the production of neoplasms in the rat and, maybe, in man also, since species of both *Gongylonema* and *Hepaticola* have been found to occur in *Homo sapiens*.

Hepaticola hepatica, as I have stated in discussing the mouse *Gongylonema*, was first seen by Rudolphi (1819) and Molin (1857), but both confounded it with *Gongylonema minimum* Molin 1857, discovered in the same mouse. This is obvious from the fact that while some of the worms (*Gongylonema*) were lodged in the stomach, others (*Hepaticola*) were " in hepate " (Rudolphi) and " were extricated with difficulty from the piece of liver in which they were embedded " (Molin). Now we know that no gongylonema has ever been found in the liver, whilst *Hepaticola hepatica* is essentially a liver parasite and that it is most difficult to separate it from the liver substance.

Hepaticola hepatica has been found not only in rats (*Rattus rattus* and *Rattus norvegicus*), mice (*Mus musculus*) and man, but also in the rabbit by Lebert in France, in the common hare by Nicoll in England, and in the prairie dog and beaver by Weidman in America.

Trichosomoides crassicauda.

A worm frequently found in the Villa Lagarina rats was *Trichosomoides crassicauda*. This singular nematode, inhabiting the uropoietic organs (renal pelvis, ureters, urinary bladder), was discovered in Ireland by Bellingham in 1840. Rayer, in 1843, found it in the urinary bladders of brown rats captured in Paris knackers' yards, and proposed to call it *Trichosoma muris decumanis*. Dujardin (1845) pointed out that it differed from Trichosomes especially in the relative length of the anterior and posterior portions of the body and should be placed in a separate genus. Von Linstow, in 1874, made it the type of a new genus for which he proposed the name of *Trichodes*, but this name being preoccupied by *Trichodes* Herbst, 1792, coleopteron, it was changed to *Trichosomoides* by Railliet in 1895.

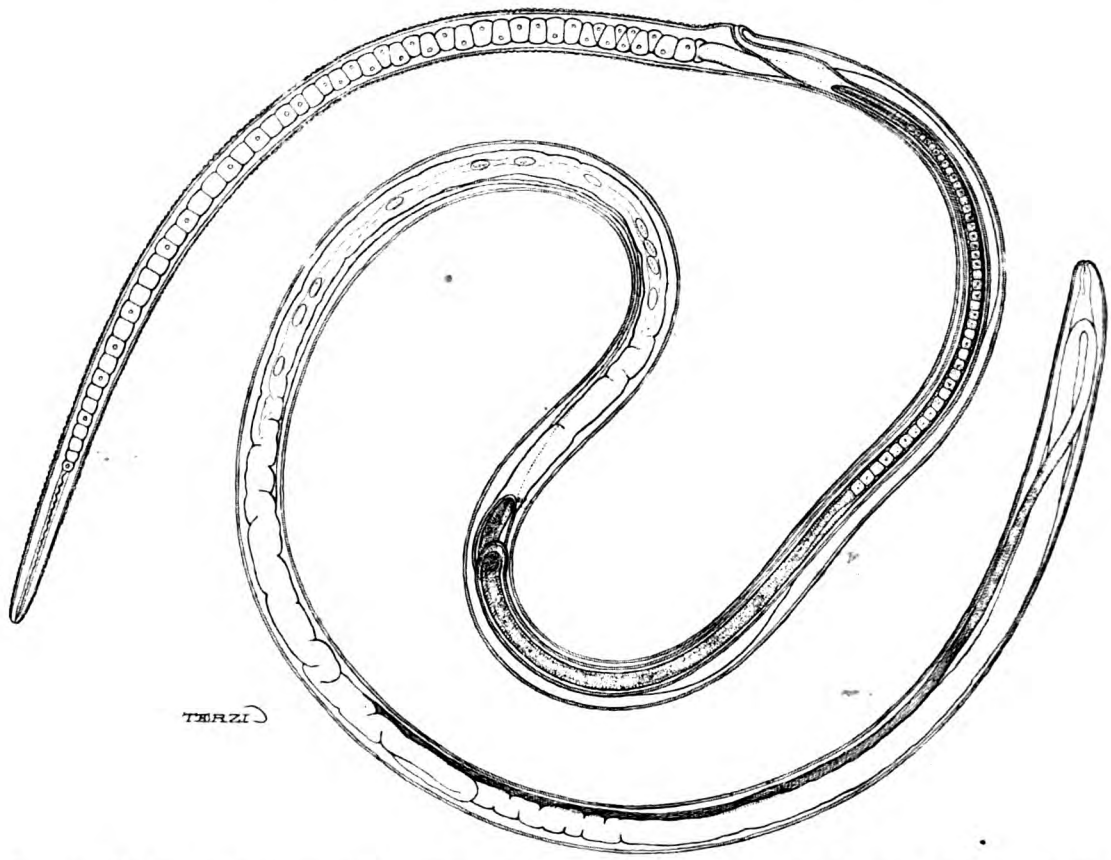


Fig. 43.—*Trichosomoides crassicauda* from urinary bladder of Villa Lagarina rat, male in female's uterus (original).

The mature female occupies the urinary bladder of its host and is a long attenuated worm measuring from 11 to 12 mm. in length. The male, seldom over 2 mm. long, is usually found parasite-like, or rather as an inquiline, in the female's vagina or uterus—a strange case of sexual dimorphism similar

to that of *Bonellia* among the *Gephyrea*, the microscopic males of which live in the female's nephridium, which acts as a duct for the spermatozoa. In young specimens, taken from the pelvis of the kidney or the ureters, the female is only about three times as long as the male it harbours, but, after reaching the urinary bladder, owing to the considerable growth of her reproductive organs, she becomes more than ten times the length of the male now lost in the mass of eggs which fill the uterus. One, two or more males may be found in the same female with their anterior extremities invariably turned towards the sexual aperture. Fig. 43 shows a young female from the urinary bladder of a Villa Lagarina rat with the male *in situ*. The male is easily discernible within the female's body by the bead-like vesicular cells which, as in the female, strung on to the posterior part of the œsophageal tube, are characteristic of all *Trichinelloidea*.

In a paper entitled " Trichodes crassicauda specifica, eine causa directa in der Aetiologie der Tumoren " (*Beiträge zur klinischen Chirurgie*, P. v. Bruns, Band LXXVI, Heft 3, Tubingen), Dr. S. Löwenstein states that he found papillomata and even malignant growths associated with the parasitism of this worm. These changes had occurred not only in the epithelial lining of the bladder where the adult worms usually are found, but, sometimes, also in the ureters and in the renal pelvis. Not only the young worms, but more particularly the eggs seemed to be the cause of epithelial proliferation, and the author thought that the ensuing neoplasms might be the result of some peculiar toxic substance excreted by the nematode.

In Holland, Dr Wassink showed me several rat bladders affected by this parasite. He considered *Trichosomoides* responsible for tumour formation as well as for calculosis, which he frequently found associated with its parasitism.

Papillomas in association with *Trichosomoides crassicauda* have been reported by Saul in 1914 and by Thomas in 1924; both authors found female worms either partially or entirely embedded in the epithelial proliferations.

In Villa Lagarina we found *Trichosomoides* to be rather common; as a rule two or three worms were present in the urinary bladder, but once I counted as many as seven. Twice we found calculosis associated with it, never any new growth.

The scarcity of urinary calculi and the absence of neoplasms in the bladders of the several rats examined in Villa Lagarina, during our short stay there last summer, in no way disproves the agency of *Trichosomoides* in the production of new growths, an agency which has been proved by the observations of Löwenstein, Wassink, Saul and Thomas. Indeed, a parallel example was presented by the larval form of *Hydatigera crassicollis*, which, though frequently found in the Villa Lagarina rats, was never seen associated with sarcoma. Yet numerous observations and experiments have proved, beyond doubt, the agency of this bladder-worm in the production of hepatic sarcoma in rats.

Muspicea borreli.

In a short note appended to the publication of my Paris lecture in the JOURNAL OF TROPICAL MEDICINE AND HYGIENE (February 2, 1925), I described a minute round-worm found by Professor A. Borrel in Strasbourg mice and given me for determination. This worm being unlike any known nematode, I proposed to establish for it the new genus *Muspicea* and call it *Muspicea borreli*. Borrel had found it in the reticular layer of the skin and in the inguinal and mediastinal lymphatic glands, also in and about cancerous tumours of the mammary glands.

Since publishing my note, I have read Haaland's paper on " Spontaneous Tumours in Mice " (*Fourth Report of the Imperial Cancer Research Fund*, 1911). Haaland examined a number of old London mice and found specimens of Borrel's nematode in the connective stroma of the mammary gland, in lung and pleura.

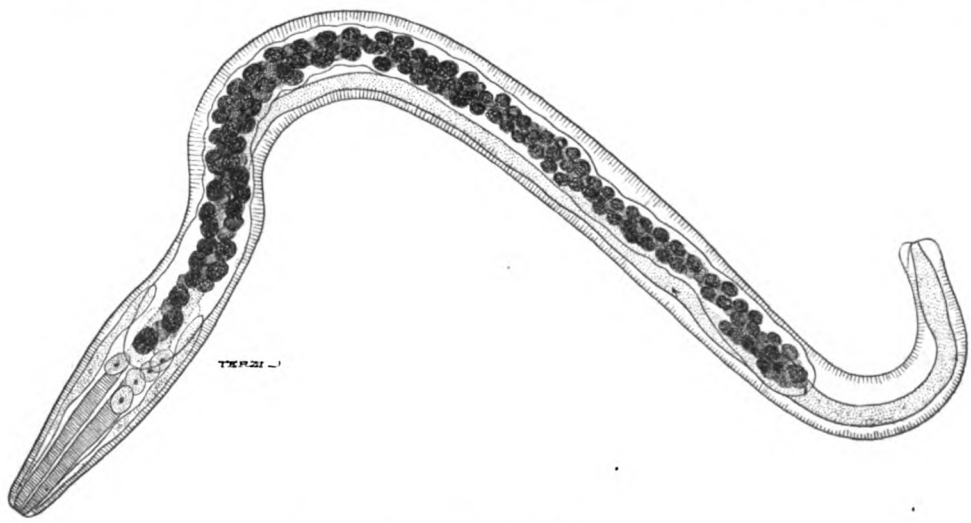


FIG. 44.—*Muspicea borreli* Sambon, 1925.
Young female.

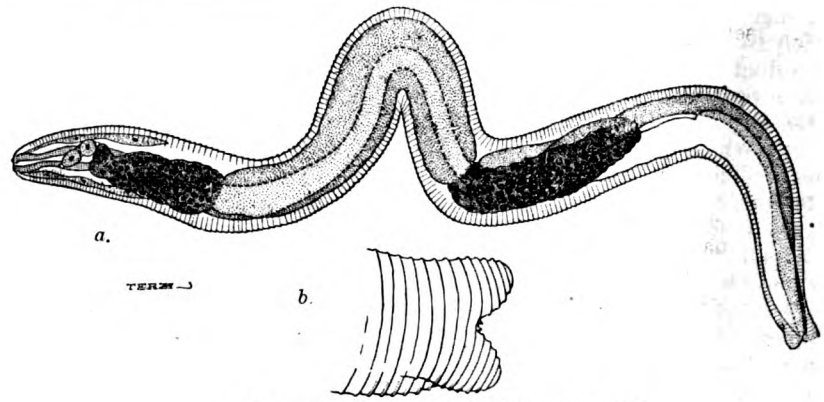


FIG. 45.—*Muspicea borreli* Sambon, 1925
a. immature form. *b*. posterior extremity.

They were exactly like those he had seen previously in Borrel's laboratory, and the photographs illustrating his paper show that they were identical with those I have had the opportunity of examining. The worms found were invariably females, either immature or fully mature, and newly extruded larvæ. The absence of males led Haaland to surmise that fertilization must occur elsewhere.

Specimens of the subcutaneous nematode, together with an intestinal Oxyurid found in the same mice, were sent by Haaland to Professors Shipley and Leiper for identification. These helminthologists identified the Oxyurid as *Oxyuris tetraptera* (since made type of a new genus: *Aspiculuris* Schulz, 1924), and stated that: "The worm in the subcutaneous tissues cannot with certainty be identified with any of the forms described; in general character and mode of occurrence it resembles most closely *Ollulanus tricuspis*."

The male being as yet unknown, it is difficult to assign the systematic position of Borrel's nematode. It is very doubtfully related to *Ollulanus*, as suggested by Leiper and Shipley. The œsophagus only slightly swollen posteriorly, the single uterus, the granular eggs, the viviparity agree, but it differs from *Ollulanus tricuspis* not only specifically, but also generically and very strikingly. Its mode of occurrence is also different.

The female of *Muspicea borreli* measures from 3 to 3·40 mm. in length, that of *Ollulanus tricuspis* barely 1 mm., yet the embryos of the latter measure, according to Leuckart, 320 microns in length, whilst those of the larger nematode measure only 270 microns. The anterior end of *Muspicea borreli* is invariably straight, that of *Ollulanus tricuspis* according to Cameron "usually coiled upon itself" (spirit specimens?). The posterior extremity in *Muspicea borreli* terminates in a bilobed tail with mammilloid lobes between which opens the anus. In *Ollulanus tricuspis* the posterior extremity is produced 0·03 to 0·04 mm. beyond the ventrally placed anal aperture and terminates in three or more cusps. At maturity, *Muspicea borreli* is merely a sack packed with a multitude of embryos all equally developed, while *Ollulanus tricuspis* shows only one to three large embryos at a time (Leuckart).

The embryos described by Leuckart as those of *Ollulanus tricuspis* are not only longer, but almost uniform in thickness throughout and their tail is prolonged into a sinuous appendix. The œsophagus is equal to a third or a half of the total length of the body (Leuckart). Those of *Muspicea borreli* are shorter, broader at the posterior extremity which ends in a bilobed tail preceded by two large papilla-like projections, one on each side of the body; the œsophagus is less than a sixth of the total body length.

Of *Ollulanus tricuspis* only the larvæ are said to be found in mice, usually coiled up and encysted just like *Trichinella* larvæ in the musculature or connective tissue. The adults are parasites of the cat and dwell within the gastric mucosa. Cat and mouse, therefore, are, according to Leuckart, the two alternating hosts in the life-cycle of *Ollulanus tricuspis*.[1] In the case of *Muspicea borreli* the adults (so far only females seen in all stages of development) and new-born larvæ are found free and motile in the subcutaneous tissue and lymphatic glands of mice; the mouse, therefore, is the definitive host and the fosterer of the larval stage; the intermediate host probably will turn out to be some arthropod.

From the first, when he found this nematode, Borrel suspected that it might play some mediate part in the production of cancer in mice. He had found it in association with mammary carcinoma and in a case of lymphoma, also in the subcutaneous tissue of tar-painted mice in process of developing cancer. Indeed he suggested that the presence of the worm and its embryos might explain why cancer develops in some tarred mice and not in others.

Haaland, supporting this view, says: "Whatever may be the life-history of these nematodes, it is natural to associate their presence with some of the local or diffuse inflammatory changes in the connective tissue of the mamma, for which, as yet, there is no other adequate explanation. It is evident that the

[1] Cameron has recently claimed to have shown that what Leuckart regarded as the larvæ of *Ollulanus* in mice were in reality those of *Synthetocaulus abstrusus*, a lungworm of the cat. No other worm belonging to the family Metastrongylidæ of which *Synthetocaulus* is a member, is known to pass through an intermediate host, and Cameron's experiments appear require confirmation.

nematodes are capable of setting up intense inflammatory processes. The site where they have rested for some time (encapsulated?) is lined by a zone of leucocytes, and other signs of inflammation follow their path. This occurs while they are living; when they lie dead in the tissues a violent reaction with leucocytes and round cells and phagocytosis is set up, and the nematodes soon become unrecognizable. The mixture of acute and chronic inflammation in the interstitial tissue with sclerotic changes is quite characteristic and in the majority of cases where this picture has been found it has been possible to demonstrate the round worm. It must be pointed out that the change is essentially one of the loose connective tissue, and the mammary gland is involved only indirectly and in so far as it is embedded on all sides in this tissue."

"The frequency of interstitial changes—inflammation and sclerosis—in the mammæ of old normal mice of the material of the laboratory is striking. There is evidence that the presence of nematodes in the subcutaneous tissue may be made responsible, at least to a large extent, for such interstitial changes. In several cases these changes co-exist with typical nodular hypertrophy, and this association suggests that the different pathological changes, inflammatory processes, sclerosis and cellularity of the connective tissue, and the nodular hypertrophy of the epithelium, may be linked together and referred to a common cause, the presence of nematodes in the subcutaneous tissue."

Heterakis isolonche.

Heterakis isolonche is a parasitic nematode limited to certain species of pheasants (*Phasianus colchicus, P. reevesi, Chrysolophus amherstiæ, C. pictus, Gennæus nycthemerus*, &c.) and responsible



Fig. 46.

for a fatal nodular disease of the cæca first noticed by Klee in Germany in 1891, and by Railliet in France the year following. It has been reported since from Italy by Galli-Valerio in 1896, from England by myself in 1908, from Holland by Wassink in 1916, and from North America (United States and Canada) by Schwartz in 1924. Several other authors, such as Letulle and Marotel (1901), Lucet and Henry (1911), have described the neoplastic spindle-celled texture of the Heterakis nodule. Railliet proposed to call the disease "verrucose typhlitis"; it is now generally known by the name of nodular typhlitis.

In my first Cancer Report, I mentioned finding *Heterakis isolonche*[1] in a Manchurian Eared-Pheasant (*Crossoptilon mantchuricum*), and I gave a photomicrograph of a section through the cæcal nodules showing the structure of the new growth, which resembles that of like nodules formed by other parasitic nematodes such as *Spirocerca sanguinolenta, Physaloptera tumefaciens, Œsophagostomum apiostomum*.

In 1916 Dr. Wassink published a very interesting monograph, "Over Gezwellen bij den Fazant, veroorzaakt door een Worm," illustrated by beautiful coloured plates. Like previous authors, he described the nodules as consisting of bundles of spindle-shaped cells, some made of larger cells with oval, lightly staining nuclei, others of smaller cells with more deeply staining nuclei. Groups of large cells and groups of small cells often lying side by side, or both types of cells may be present in the same bundle. The intercellular substance is scanty in amount and difficult to detect. The new capillaries are lined by a single layer of endothelial cells. The cellular clumps are separated from one another by connective tissue and the nodule is completely encapsuled. The histological appearance of the growth is that of spindle-celled sarcoma, or of a many-celled fibroma. The neoplasm is usually confined to the cæca, but may occasionally occur in the large or small intestine. It lies under the mucosa, between mucous and muscular coats, but it may invade the muscular coat and even reach the serosa. Just like a plant gall, it is invariably associated with the presence of a parasitic larva. Metastases (without worms) are unknown.

[1] In 1908, in a paper on "The part played by Metazoan Parasites in Tropical Pathology" (Journal of Tropical Medicine, January 15, 1908, I pointed out that probably *Heterakis isolonche*, as also *Ascaris lumbricoides, Syngamus trachealis, Spirocerca sanguinolenta, Strongylus vulgaris, Œsophagostomum apiostomum*, and other helminths, did not reach their ultimate station (habitat of fully mature stage) directly by sliding down the gullet or the wind-pipe, as was generally believed at the time, but that they penetrated either skin or mucous membrane and actively migrated through the body, travelling by way of the blood-stream, or along lymph vessels or connective-tissue paths, stopping on the way, in suitable organs, for growth and development. Thus *Spirocerca sanguinolenta*, which occurs in dog, fox, wolf, and other animals, is usually found in fibromatous nodules in the œsophagus or stomach, just like *Heterakis isolonche* is found in cæcal nodules, and one might well think with Morgagni (1764), with Davaine (1860), with more recent authors that the dog's blood-red worms, in their larval stage, had bored their way through the mucosa and settled in the loose connective of the submucosa there to attain maturity, were it not that spirocerca nodules may be found also in the most diverse parts of the body such as the duodenum, the lungs, the bronchia, the trachea, the nasal cavities, the lymphatic glands and the walls of the aorta. Likewise, *Strongylus vulgaris*, in its adult stage, is found in the horse's cæcum, but its immature stages are found in the lungs, the liver, the mesenteric ganglia, and more especially in the anterior mesenteric artery where they produce

Wassink seems inclined to believe that the growth is brought about by the secretion of some chemical substance which incites cell division.

Some authors state that they have found mature worms in the cæcal nodules of pheasants infested by *Heterakis isolonche*. This is possible, because here they reach maturity, but I have found only immature worms and, as a rule, larval forms. Quite recently (1924) Schwartz has corroborated the presence of only early stage larvæ and immature forms in the nodules, while larger mature forms occur in the lumen of the cæca. He believes that the early-stage larvæ enter first the cæca and, penetrating the cæcal mucosa, encyst in the submucosa, there to grow and attain maturity. So far, experimental evidence is lacking.

Schwartz states in his paper that "Lucet and Henry re-examined the material which formed the bases of the reports of Railliet and Lucet (1892), of Letulle and Marotel (1901), and Sambon (1908), and found that the heterakids involved were not *Heterakis gallinæ*, but *Heterakis isolonche*." The inclusion of my name in this list is out of place; Lucet and Henry never examined any material of mine, neither did I ever mention finding *Heterakis gallinæ*. My specimens were diagnosed from the first as *Heterakis isolonche*, and, unlike Schwartz, I did not find any free specimens of *Heterakis gallinæ* in the cæcal cavity of the pheasants I examined, whilst, like and before Lucet and Henry, I did find sexually mature specimens of *Heterakis isolonche*.

Relying chiefly on literature, Wassink proposed the establishment of a new species under the name of *Heterakis neoplastica* for the exceptionally large specimens he had found in the cæca of gold pheasants in Holland. Dr. Baylis, to whom I handed over the heterakids kindly given me by Dr. Wassink, compared them with material in the parasitological collection of the British Museum (Natural History), and came to the conclusion that the formation of a new species was not justified, the alleged differences being due chiefly to insufficiency or inaccuracy of description by previous authors.

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the well-known worm aneurysms first discovered by the Dutch anatomist, Fridrik Ruysh, in 1665. There can be no doubt that the blood-stream is the highway followed by a host of parasites. Indeed, in some, intra-uterine infestation has been observed. Here, in the absence of all other forms of infestment, necessarily, the young migrating parasite must have reached the placenta by way of the uterine arteries and the fœtus through the umbilical vein.

When I first suggested (JOURNAL OF TROPICAL MEDICINE, January 15, 1908) that *Ascaris* in animals and man did not develop directly in the small intestine after ingestion of the embryonated egg, but migrated through the body and sojourned in certain organs, such as the liver, before re-entering the bowel at maturity, I was laughed at. Now the researches of Stewart (1916), Yoshida (1917), Ransom, Foster, Cram, Fülleborn, Brumpt, Mosler, Lutz and others have fully confirmed my views, yet only Manson (*Brit. Med. Journ.*, 1917) remembered my researches at the Prosectorium of the London Zoological Society and stated in his review of Stewart's work, "This certainly goes a long way to prove Sambon's view that before attaining sexual maturity the parasite must enter the tissues of its human host. Sambon pointed out that the papilla or beak, a conspicuous feature in the larval ascaris, indicated that the little organism at an early stage of its existence bores its way into the tissues."

OPISTHORCHIS FELINEUS.

Among the various helminths capable of inciting cancer in man, I mentioned, in my second report (February 2, 1925), the tiny, reddish liver-fluke, *Opisthorchis felineus*, discovered in 1884, by Rivolta, in cat and dog in Italy. I recalled that, already in 1901, Askanazy had found this trematode in association with primary hepatic cancer among the fisher-folk of the Baltic coast. He described the lesions it produces: the congestion of the liver, the proliferation of the epithelium of the obstructed, dilated, bile-canaliculi, the appearance of new-formed bile capillaries, the proliferation of the connective tissue, the hypertrophy of the glands and the production of adenomatous and papillomatous formations followed by cancerous degeneration, the whole clearly determined by parasitic irritation.

Cancer of liver and gall-bladder is exceptionally common among the fishermen of the Baltic shores. What can be the cause? Dr. Rindfleisch's researches elicited the fact that the fishermen of this region are in the habit of eating raw fish, especially during their fishing cruises, hence they are heavily infested by *Opisthorchis felineus*; the biliary ducts being crammed with hundreds of the minute, lanceolate cat-flukes.

Since its discovery in Italy, *Opisthorchis felineus* has been found in France, Hungary, Roumania, Eastern Prussia, Holland, Sweden, Russia, Siberia, Japan and Tonquin, not only in the cat, but also in dog, fox, glutton and man.

The life history of *Opisthorchis felineus* has been worked out by Askanazy. The ciliated miracidium, which escapes from the operculated egg-shell, invades a fresh-water mollusc (probably *Dreissensia polymorpha*); later, having reached the cercaria stage, it leaves the mollusc and encysts in the skin and musculature of some species of cyprinoid fish, such as carp (*Cyprinus carpio*), barbel (*Barbus barbus*), roach (*Rutilus rutilus*), tench (*Tinca tinca*), bream (*Abramis brama*), or Ide (*Idus idus*). Man, cat, dog and other definitive hosts became infested by eating these fishes raw or underdone.

Verdun and Bruyant, in Tonquin, found *Opisthorchis felineus* associated with a slightly larger hepatic fluke (*Clonorchis sinensis*) of man and certain fish-eating mammals such as dog, cat, badger and marten. Kobayashi (1911) discovered that, like *Opisthorchis felineus*, *Clonorchis sinensis* also has for second intermediate hosts certain fresh-water fishes, such as *Pseudorasbora parva*, *Leucogobio güntheri*, *Acheilognathus lanceolata* and *Carassius auratus* or the "gold-fish," in the skin and flesh of which it lies in ambush. *Clonorchis sinensis* is widely spread among the coast inhabitants of China, India, Indo-China and Japan, and it is on account of this peculiar coastal distribution that, as early as 1908, Professor H. B. Ward was able to suggest fish as the probable cause of infestation.

These two liver-flukes are joined, in China and Japan, by a third trematode, *Schistosoma japonicum*, a blood-fluke which also gives rise to a grave biliary cirrhosis, long known in Japan by the name of

Katayama disease, from the district of Katayama. According to Professor Katsurada, this schistosomiasis is very common in the central provinces (Bingo, Yamanashi, Hiroshima) of Japan and even more so at Saga, in the Island of Kyushu. Now, from a totally different source, I learn that, in this very island of Kyushu, primary cancer of the liver is three times more frequent than in the rest of Japan. Is not this striking? Does not the coincidence of the greater prevalence of liver-fluke infestation with the greater prevalence of liver-cancer in the same area indicate a very probable relationship of cause and effect?

Opisthorchis felineus, *Clonorchis sinensis* and *Schistosoma japonicum* produce, every one of them, biliary cirrhosis which may well be looked upon as a "pre-cancerous" condition, since obviously it favours the development of hepatic sarcoma. In Japan, in China, in India, the connection between biliary cirrhosis and primary hepatic cancer is well known.

But that which forcibly demonstrates the cancer-inciting agency of *Opisthorchis felineus* is an observation which has all the distinctiveness of a purposely made laboratory experiment.

On the so-called "Amber Coast" of North-east Prussia, together with *Opisthorchis felineus* we find the "broad tapeworm" (*Diphyllobothrium latum*) which begins life by entering the body cavity of some fresh-water copepod such as *Cyclops strenuus* or *Diaptomus gracilis*. When the latter is swallowed by some fresh-water fish, such as pike (*Esox lucius*), burbot (*Lota lota*) or perch (*Perca fluviatilis*), the cestode larva ("plerocercoid") encysts among the various organs or the musculature of the fish, to be ingested finally by man, cat, dog or fox.

The Kurisches Haff, in East Prussia, between Königsberg and Memel, is a bay or lagoon five miles in width, cut off from the Baltic by the Kurische Nehrung, a narrow peninsula or land spit 60 miles long and 1 to 2 miles wide; made of high sand dunes (some 250 ft.) partly covered with scrub, grass-associations and trees planted, at great cost, to fix the dunes. On it are a number of fishing villages with an aggregate population of 2,300 inhabitants who still speak Kurish, a dialect of the Lettish tongue. The low and swampy mainland coast is trenched by numerous fresh-water streams which empty into the bay; the larger are the Russ, Minge, Dange, Gile, Arge and Deime. There are no streams on the peninsula. The fisher-folk inhabiting the Kurische Nehrung are exactly like those of the mainland coast in type and habits.

Primary cancer of the liver is common on the mainland coast, yet it is said to be absent from the Kurische Nehrung. How explain this difference? The inhabitants of the peninsula and those of the mainland coast are both equally infested with the broad tapeworm (*Diphyllobothrium latum*), but only those of the mainland coast harbour the liver-fluke (*Opisthorchis felineus*). Among the shifting sand dunes of the peninsula there are no streams and, therefore, no fresh-water snails. The absence of streams with fresh-water fish and molluscs, the very local habitats of the majority of fish which foster the liver-fluke and probably a greater consumption of salt-water fish explain the absence or rarity of *Opisthorchis felineus* in the inhabitants of the peninsula and, no doubt, as Herxheimer suggests, the absence of opisthorchiasis, or helminthic biliary cirrhosis, explains the absence of primary hepatic cancer.

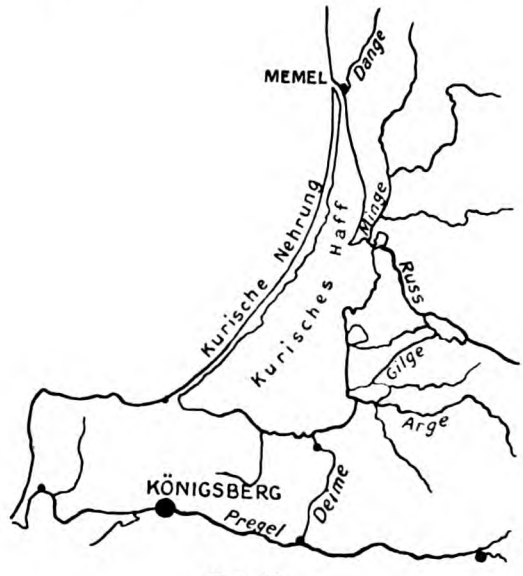


FIG. 47.

PHYTOLOGICAL RESEARCHES.

In order that I might leave nothing unattempted in the study of cancer houses and their surroundings, I sought, and fortunately secured, the expert and able co-operation of Mr. J. Ramsbottom, mycologist in the British Museum (Natural History). I was anxious to collect and determine the various kinds of fungi found in the woodwork of houses, cellars and stables and to ascertain which are the species that attract fungus-eating arthropods,[1] such as cellar beetles (*Blaps*) and wood lice

[1] We know not when man first availed himself of moulds and other minute fungi to ripen and flavour some of his cheeses, such as Roquefort, Stilton, Gorgonzola, Brie, Camembert—nor do we know when he first began to cultivate mushroom gardens in natural caves or artificial cellars, but here, certainly, he was anticipated by certain beetles (*Scolytidæ*) and by neotropical ants belonging to the myrmicine tribe Attii, who feed almost exclusively on fungi. The attiine ants grow their fungus food in subterranean chambers, on mulch beds made of leaves and flower-petals chewed to a pulp, mixed with dung and wetted with their own digestive juices. Now, without these digestive ferments, the fungus spores could hardly germinate. We have, therefore, between ant and fungus a true and strange symbiotic association, discovered by Thomas Belt in Nicaragua and ably investigated by Moeller, Tanner, Von Ihering, Dr. Goeldi and Jakob Huber. I had the opportunity of studying it in Jamaica thirteen years ago. The gardens seem to be pure cultures of a single fungus; the tiny plant is never allowed to form aerial hyphæ or fructifications, but, instead, through long domestication and selection on the part of the ant "champignonniste," it has been made to produce many rounded swellings or food-bodies (bromatia) on its hyphæ, miniature "Kohlrabi heads," as Moeller has termed them.

(*Oniscoidea*) so frequently found in stables, cellars and damp lower floors of rural dwellings.

Cancer and Dry-rot.

It is well known that the dry-rot fungus (*Merulius lacrymans*) and other hymenomycetous pests (species of *Polyporus*, *Poria*, *Coniophora*, *Fomes*, *Trichothecium*, *Rhacodium*, &c.) of woodwork in damp dwellings and cellars have long been looked upon as injurious to health and, by some (Klug and others), as causative of cancer. This alleged cancerigenous property of house fungi, however, and more especially of *Merulius lacrymans*, the true "house fungus," has been disputed by Gottschlick, Flügge, Frief, Mez and other competent mycologists.

Toadstools and Cancer.

In his report on fungus pests found in the human dwellings and stables of the Trentino, Mr. J. Ramsbottom has casually mentioned a few of the mushrooms locally used as food. In Italy, the consumption of esculent fungi, fresh or dried, is large, not only in quantities, but also in the number of species. I have seen the market-places of Trento and Bolzano ablaze with the gold-yellow of the piles of "finferli" or "galetti" (*Cantharellus cibarius*) exposed for sale. I have feasted on Cæsar's mushroom—the "uovolo" (*Amanita cæsarea*),—on "spugnola" (*Morchella deliciosa*), on "porcino" (*Boletus edulis*) and other species, all truly delicious, and shall be pleased to eat them again, even though a good lady of Trento assured me that fungus eating may give rise to cancer.

The belief that certain "toadstools" cause cancer is old and general among the peasants of the forest department of the Landes, in south-western France, where a fungus of the phalloid group, the beautiful, but malodorous "lattice stinkhorn" (*Clathrus cancellatus*) is actually called "cancer" and is avoided carefully. When found, it is usually buried beneath a thick layer of earth, lest someone should touch it inadvertently and thereby contract the dread disease. Jean Thore, a physician, of Dax, who mentions this belief in his "Essai d'un Chloris (Flora) du Département des Landes," 1803, says: "The peasants imagine, I know not why, that whosoever touches it, acquires the disease by the name of which the plant is designated." Badham, in his "Treatise on the Esculent Funguses of England," says they "call it Cancrou, or cancer."

Possibly the exceedingly offensive indoloid scent of the fungus, not unlike the putrescent odour of the fœtid "ichor" exuding from an ulcerated carcinoma, may have suggested the belief.

Clathrus cancellatus is not uncommon throughout the Mediterranean region; northwards, it extends to the Channel Islands, the Isle of Wight, Belgium and Holland. Linnæus saw it for the first time between Amsterdam and Haarlem in 1735. It has been collected at a few stations in Florida and Georgia in the United States of America.

When young and still enclosed in its volva, it looks like an egg and is so called. At maturity, the investing membrane bursts and the plant springs up, like a Jack-in-the-box, not by rapid growth but by expansion of its cells. It has a striking appearance; a red spheroidal receptacle of lattice-work composed of obliquely anastomosing bars. To the upper part of its inner surface is attached the greenish, viscid gleba, or fruiting portion, which, deliquescing, becomes excessively fœtid. The noisome odour of putrescence attracts carrion-flies needing proteolytic organisms to liquefy the flesh on which they oviposit and thus prepare their maggots' pap. By this means, so frequently used in flower-pollination, by the Aroideæ and other fly-alluring plants, *Clathrus* insures the dispersion of its spores.

The "eggs" of *Clathrus cancellatus* are eaten by Italian peasants, just as those of another species, named *Clathrus cibarius*, are used for food by the natives of New Zealand.

PLANT CANCER.

With regard to plant cancer, my investigations were limited almost entirely to the ascertainment of its presence in the districts visited.

Crown-gall is well known to the agriculturists, pomologists and wine-growers of the Trentino, who call it "gozzo" (goitre), "rogna" (scab) and "marezzo" (crispation).

The very day we reached Trento, I noticed in the garden of the Hôtel Mayer a rose-bush presenting a remarkable example of fasciation—a straight, flat, ribbon-like stem over 3 ft. high and about 2 in. broad. This striking malformation, usually brought about by the penetration of foreign organisms into the growing point, has been produced experimentally by the inoculation of *Bacterium tumefaciens* (Smith).

In Villa Lagarina, an intelligent youth of the Bolner family (which had lost three of its members from cancer) when asked about "gozzo" in plants, at once procured me a specimen from among firewood, stacked in a corner of the courtyard where we were, and told me he had seen the disease on cherry, peach, almond and grape.

At the Provincial Agricultural Institute in S. Michele, on the Adige, Signor Giglio Boni, Lecturer on fruit-growing, said crown-gall was well known in the district and occurred in the institute's nurseries. He showed me several striking specimens in the institute's museum and, later, kindly sent me a typical root-gall upon cherry.

At Trento, Commendatore G. Catoni, President of the Provincial Agricultural Council, gave me several specimens of crown-gall from apple, pear and grape with some notes on the disease which, translated into English, read as follows:—

"This disease has been known to our agriculturists for at least a century, though the specific cause remained a mystery. No great importance was attached to it at first, because its incidence was sporadic and caused little damage.

"In 1910 nursery stock was affected more frequently by crown-gall, first in the nurseries of the Upper Adige, later in those of the Trentino.

"After the war, on account of frequent complaints ıade by fruit growers, I paid special attention to this ıalady which, as a rule, after some years, leads to the eath of the infected plant.

"Nursery stock imported from Germany was made the bject of scrupulous examination and, in latter years more articularly, we noticed a recrudescence of the disease pecially in plants which reached us from Northern ermany, whence the disease seems to have been introuced.

"By means of a vigilant Custom House service we have een able to withdraw from circulation, and thereby estroy, many infected plantlets.

"The plants more frequently attacked are: Peach, ear, apple, quince and kaki, or Japan persimmon *Diospyros kaki*). The majority of tumours are found pon the roots, but overgrowths may occur on stem and imbs.

"I am now awaiting the result of investigations which re being carried out in the localities more heavily and eriodically affected, whilst myself attending to a series f experiments throughout the region in order to study he effects of the inoculation of *Bacterium tumefaciens* on arious kinds of fruit trees planted in different soils. At he present moment I am not prepared to indicate the ndemic areas, but, at the end of the inquiry, I trust I nay be able to map out the more heavily infected centres vithin the region.

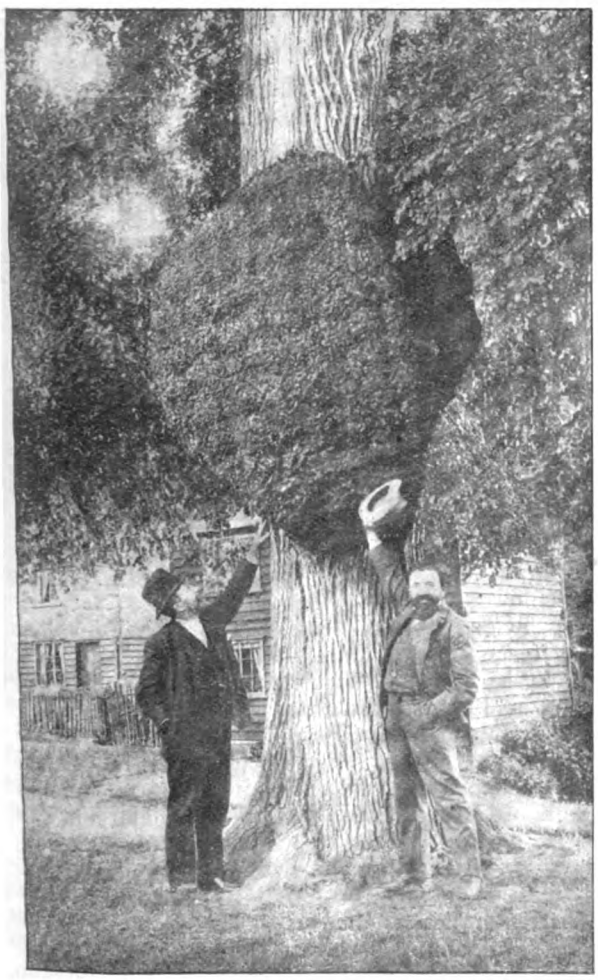


FIG. 48.—Sir James Cantlie and Surgeon-General Rho, Italian Navy, examining an enormous growth on elm tree at Buntingford. (Photograph by Dr. Sambon, taken in 1899.)



FIG. 49.—Crown gall on apple tree.

"Meanwhile, I believe I can assert that the injury caused by *Bacterium tumefaciens* is steadily increasing from year to year.

"Information received from other Italian regions also shows that considerable importance is ascribed to the damage caused by *Bacterium tumefaciens*. This organism, according to experts, is exhibiting a decidedly infectious character.

"With regard to remedies, there is, so far, nothing sure, nothing positive."

In Milan, at the superb Serotherapeutic Institute, directed by Professor Belfanti, we were shown a number of tomato plantlets which had been inoculated with pure cultures of *Bacterium tumefaciens* and presented the characteristic swellings.

In the Province of Rome, on my way from Sambuci to Saracinesco, while climbing the steep mule-path that leads to the old Saracenic fortress, I noticed that the hedging brambles were tumoured. Some of the swellings were large pithy galls produced by a gall-wasp, others, along the stem, were characteristic of crown-gall, a disease which frequently affects the blackberry, as also its close relative the raspberry, though the overgrowths on the latter usually are smaller and confined to the crown and roots.

Two main cultures clothe the fertile valleys of Tridentine Venetia: grape and pomaceous fruits. Viticulture was by far the more extensive in the past, but, within the last half century, the cultivation of pomaceous and drupaceous fruit trees has increased greatly and is now displacing the bacchic vine. The chief fruit-culture is that of the apple, in several excellent varieties, then follow pear, peach, apricot, cherry, walnut and chestnut. All

these and the grape-vine are more or less susceptible to crown-gall. I have seen the disease, in its "gall," "broom" and "hairy-root" forms, on rose, pear, apple, cherry and grape. I have seen it also, whitish, translucent, almost opaline, on a geranium (*Pelargonium*) in a flower-pot at the window of a house in Lavis. That crown-gall is a serious disease of the grape-vine in Northern Italy is a fact long known, and, indeed, it is to the study of the "rogna" or "tuberculosi" of the grape in Italy that we owe our knowledge of the disease.

Travelling through Holland and Italy one is impressed by the frequency of woody knarls and warty overgrowths on trees, especially when the latter are planted in close rank along the interminable country roads and canals. Some of these overgrowths, on collar, stem or limb of poplar, elm, chestnut or willow, doubtless are true plant-cancer. All, whether burrs, cankers, wood-nodules or witch's-brooms, so far as we know their cause, are the outcome of parasitism.

Dr. Erwin F. Smith's remarkable investigations and Dr. Ferdinand Blumenthal's recent experiments have focused attention on crown-gall and, no doubt, more may be expected from their researches.

Crown-gall (crown-knot, limb-gall, root-gall, hairy-root, woolly-root or plant-cancer) is a disease of world-wide distribution remarkable for the large number of plant families subject to its ravages. Among some of the best-known host-plants are: tobacco and many food-plants such as potato, cabbage, cauliflower, tomato, turnip, carrot, sugar-beet, red-beet, radish and lettuce, hop, clover and medic, blackberry, raspberry, grape, cherry, plum, peach, apricot, pear, apple, quince, almond, chestnut, walnut and avocado. Numerous floral and ornamental plants are subject to its attacks, I need but mention the rose, carnation, geranium, chrysanthemum, honeysuckle, sunflower, oleander, poplar and willow.

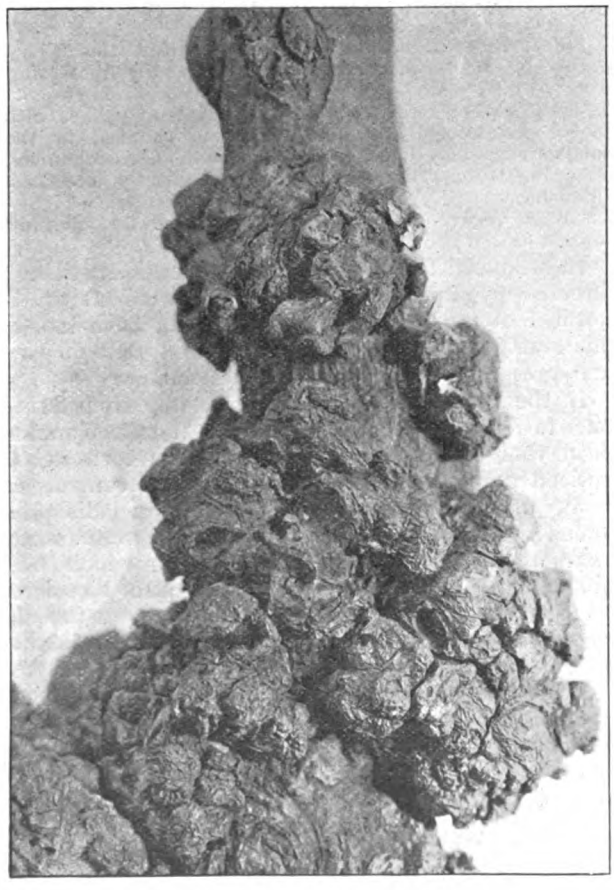


FIG. 50.—Crown gall on pear tree.



FIG. 51.—Crown gall on grape-vine.

For obvious reasons, crown-gall is more prevalent and better known in cultivated than in wild plants, just as animal-cancer is more prevalent and better known in domesticated than in wild animals.

Whilst in some plants the disease more commonly affects the "crown" (that part where root and stem meet) or the roots, often giving rise to bunches or tufts of closely matted rootlets with enlargements at their base (hairy-root), in others (quince, poplar) it produces gall-like swellings on various portions of the limbs and twigs, often covering an entire limb with irregular warty outgrowths.

The malignancy of crown-gall in plants varies considerably. As a rule, it is greater in Dicotyledons than in Monocotyledons. In many woody trees it does not seem to cause much injury. Thus, in pear, apple and cherry, its action is usually slow.

ır well-rooted trees may outgrow the disease in a ear or so, but there are varieties of apple in which appears to be very destructive. Grape, peach, mond, raspberry, rose and willow are seriously jured and frequently killed. Other plants, such olive, onion and garlic, seem to be immune.

In susceptible species the amount of damage deends greatly on the age of the plant and on the cation of the new growth. Young plants are more riously injured and may be killed by a terminal id inoculation. In severe attacks the affected ants become stunted and sickly, their leaves

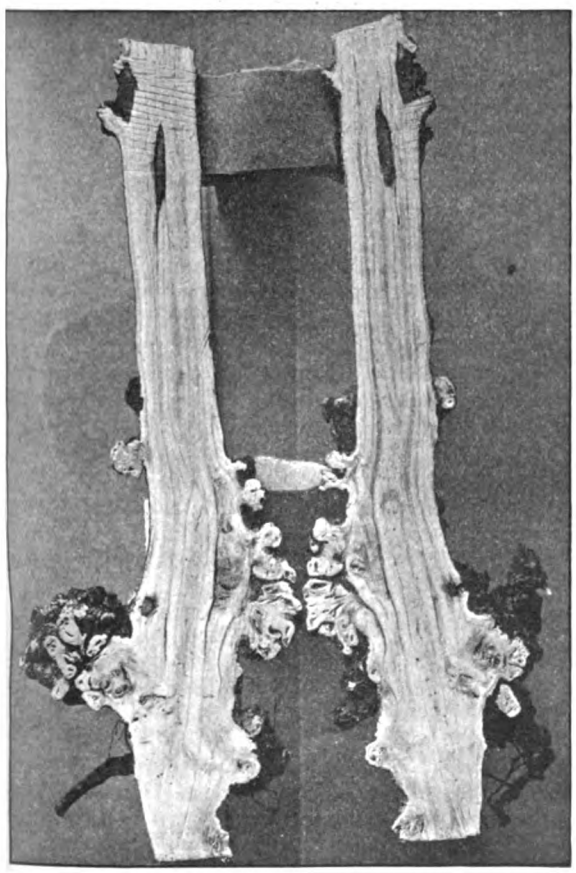


FIG. 52.—Longitudinal section of pear-tree stem with crown-gall, showing tumour-strand.

mall and chlorotic (yellow), while unfruitfulness as been noted.

It was Dr. Erwin F. Smith, doyen of American lant pathologists, who, in 1909, first pointed out he striking resemblance existing between the rown-gall of plants and malignant animal tumours.

Like cancer in man, so the plant overgrowth egins with frenzied hyperplasia. Its cells proiferate in an abnormal manner, dividing hastily, epeatedly, immaturely and with extraordinary apidity; they become small, atypical, disoriented, xhibiting a strong affinity for stains. Their reatly reduced cytoplasm contains numerous coarse ranules. On account of incomplete development, he tumour-cells assume an embryonic appearance; they divide mitotically or amitotically and their nuclei may be lobed or cleft; often several nuclear fragments are seen in one cell.

The rapidly multiplying cells foam up, as it were, into a mass of non-capsulated, small-celled neoplastic tissue supported by a variable amount of stroma and of twisted, distorted, thin-walled vessels (tracheids and sieve tubes corresponding roughly to blood-vessels and lymph channels) developed out of the surrounding normal tissues.

As the tumour grows, it destroys contiguous tissues by compression or infiltration, but, finally, being subject to early decay, on account of imperfect vascularization, it is in turn destroyed by a variety of disintegrating bacteria and fungi.

The structure of the neoplasm varies according to the tissue primarily affected. The majority of tumours are made up of the ordinary ground or parenchymatous-cells (cortex, pith, medullary-ray-cells) and may well be compared to the connective-tissue growths or sarcomata of animals; others, being composed mainly of epidermal elements, parallel the epitheliomata; others again, containing teratoid elements in addition to cancerous cells, are fully comparable to the atypical teratoid tumours of man and animals.

Embryonal teratomata in crown-gall were first observed by Smith in 1916 in shoots of red-flowered pelargoniums and since repeatedly obtained in a great variety of plants (*Citrus*, *Lycopersicum*, *Okra*, *Brassica*, *Beta*, *Nicotiana*, *Ricinus*, *Opuntia*, *Rosa*, *Fuchsia*, *Hibiscus*, *Allamanda*, &c.) by stimulating proliferation either in the leaf axils wherein lie dormant buds, or in toti-potent cells capable of reproducing shoots.

In the "wonder plant" (*Bryophyllum pinnatum*), called "life-plant" in the Island of Barbados, where I first saw it, adventitious plantlets invariably develop in a normal way from the marginal indentations of its leaves, whenever the latter are torn off the stem. The Barbadians suspend fragments of the leaf by a thread to watch the "wonder." These leaf-plantlets eventually grow into normal plants, but in crown-gall we witness a strange awakening of toti-potent cells induced by a pathogenic stimulation, and the shoots, buds and roots which arise, form, as a rule, a jumbled mass of incomplete, distorted structures which soon perish.

The most striking feature of crown-gall, the feature which certainly likens plant-cancer to animal-cancer, is the development of secondary tumours from the primary neoplasm invariably reproducing the structure of the mother tumour, no matter where arising. These secondary tumours are lateral offshoots from a tumour-strand, a continuous chain of proliferating tumour-cells exactly like the chain of cancer-cells which in animals spread along the lymphatics by a process of continuous forward growth. Mr. Sampson Handley has termed it "permeation" and proclaimed it to be the "master process of cancer dissemination." These parenchymatic tumour-strands in plants are sometimes large enough to be clearly visible to the naked eye in both

cross and longitudinal sections, but more often consist of a thread of cells so delicate that it is difficult to recognize them, even under the microscope.

Nothing could have seemed stranger, more puzzling, than to find in secondary tumours the characteristic elements of the tissues in which the primary growths arose, such as bone in brain tumours, the bright yellow secretion of bile in lung metastasis, lignin (wood) and the concentric closed structure of a stem, or again " root-structure " in leaf-galls, yet nothing is easier to understand when one remembers that secondary tumours arise either in direct continuity with the primary growth by means of tumour-strands, or from detached portions of proliferating tumour-cells carried through the vascular system to another part of the host's economy and there ingrafted.

The initial tumour in every instance, so far as we know, appears in a wound caused either by sunscald, the battering of hailstones, agricultural implements or the gnawing, puncturing, boring of rodents, insects or nematodes.

The size of the overgrowth may vary from one to several inches in diameter. At first it is small, relatively smooth and soft, whitish, greenish or slightly roseate, almost translucent; later it increases in size, becomes hard, warty and browned. As in animal-cancer, so also in plant cancer, the youngest growing part of the tumour is at the periphery, while the oldest, decaying, necrotic part is central.

In plant-cancer, as in animal-cancer, the disease recurs after excision or cauterization, unless the whole of the morbid growth is removed. Sometimes crown-gall recedes of its own accord just as cancer may disappear, for unknown reasons, in animals and man. Finally, like malignant tumours in animals, plant-cancer can be grafted on to other plants of the same species.

The parasitic nature of crown-gall had been suspected long ago, indeed, experiments by numerous investigators had proved that the disease is communicable, because infection of susceptible plants was obtained by planting young trees in the vicinity of diseased ones, by burying fragments of galls in contact with the roots of sound trees, by grafting and by inoculation with macerated galls. Bacteria were incriminated by Corvo in 1885, by Cuboni in 1889, by Comes in 1892; other phytopathologists suggested fungi. As late as 1900 we found Professor Toumey suspecting a myxomycete which he names *Dendrophagus globosus*.

The credit of having demonstrated the bacterial nature of the disease, by means of inoculations from pure cultures, belongs to F. Cavara, Professor of Botany in the Royal University of Naples.

" Although Cavara's account is meagre," says Dr. Erwin Smith, " there is little doubt in the light of our own experiments that he had the right organism and reproduced the disease with it as he says he did. His experiments, however, were so few in number that they did not convince anyone and were generally overlooked."

Cavara studied crown-gall in the grape-vine from material obtained near Venice. He published a preliminary note in 1895, a fuller paper in 1897 and a third one in 1890. As first pointed out by him, the gall-forming bacterium occurs in small numbers scattered through sound-looking tissues and is very difficult to see when stained. He says:—

" I cultivated the bacterium in gelatine prepared with green shoots of the vine, and the Petri dish poured plates gave circular, flat colonies of nacreous hues, which did not liquefy the surrounding gelatine. . . . With cultural material many times renewed by transfer, I made inoculations in the Botanic Garden of Pavia. T-shaped incisions, after careful sterilization, were inoculated either in the lower internodes of shoots of the year, or in the upper internodes, while as many were simply incised without inoculation of the virus for purpose of control. Of two European grape-vines, one was inoculated in four of its branches, the other merely incised for control. All of the four inoculated branches produced overgrowths, not of large dimensions, it is true (1 to 1·5 cm. in diameter), but of the same form and structure as those on the Udine vines."

In 1907, Smith and Townsend published the results of their researches on crown-gall made in the cultivated marguerite, or Paris daisy (*Chrysanthemum frutescens*). Like Cavara, using sub-cultures descended from agar-poured-plate colonies, they introduced this organism by means of needle pricks into healthy daisies and other plants (tobacco, potato, tomato, sugar-beet and peach) and, under favourable conditions (young tissues), succeeded in reproducing characteristic tumours in 100 per cent. of infections. From these experimentally obtained overgrowths the inoculated organism was recovered, cultivated and again successfully used to reproduce the disease. Control plants remained invariably healthy while punctures made with sterile needles never gave rise to overgrowths.

" I insert my infected needle," says Dr. Smith, " and I obtain a tumour. I insert a sterile needle and the wound heals normally. Into one branch of a young Paris daisy I set my infected needle fifty times and obtained fifty tumours; at the same time into the twin branch I set a sterile needle fifty times and obtained no tumours whatsoever, but only a normal healing of the wounds."

Smith and Townsend proposed the name of *Bacterium tumefaciens* for the crown-gall organism. Its morphological and cultural characters are as follows:—

Bacterium tumefaciens is a short rod with rounded ends, motile by 1-3 polar flagella; measures 1·2 to 2·5 microns by 0·5 to 0·8 microns; neither spores nor capsules demonstrated; pseudo-zoöglœæ occur; involution forms present; stains with the usual aniline stains; Gram-negative; on agar, slow, four to six days at 25°; filiform, raised, white, glistening, somewhat slimy; potato, growth rapid, white, smooth, wet-glistening; gelatine stab, filiform, no liquefaction; blood serum, moderate; broth, ring or pellicle, clouding absent or inconspicuous; milk, coagulation delayed, curd not peptonized, litmus gradually blued, then reduced; silicate jelly, slow white growth; Cohn's solution, scanty or absent; Uschinsky's solution, scanty, not viscid; NaCl bouillon, 4 per cent. inhibits, 3 per cent. retards; bouillon over chloroform, growth unrestrained, no gas from sugars; ammonia is produced; nitrates not reduced; indol production small; thermal death-point 51°, optimum reaction between — 14 and — 24 Fuller's scale, opt. temp. 25° to 28°, max. 37°, min. positive at 0°; killed readily by drying; moderately sensitive to sunlight, invertase and rennet thought to be produced.

From the first, when together with his associates, Dr. Erwin Smith isolated *Bacterium tumefaciens* from crown-gall overgrowths, he thought that the same, or a very similar organism, might be the inciting agent of cancer in animals and man. At that time, when pathologists denied the parasitic nature of cancer in man and animals, when many phytopathologists denied the very existence of bacterial diseases in plants, the suggestion of a schizomycete causative of cancer in man, animals and plants must have seemed preposterous. Yet Smith inoculated *Bacterium tumefaciens* in brook-trout (*Salmo irrideus*) and other cold-blooded animals, persevering in spite of obstacles and failures.

In a paper on "Cancer in Plants," read before the Seventeenth International Congress of Medicine, held in London, August 1913, Dr. Smith said:—

"I have obtained indications, at least, in fish inoculated with this organism, of overgrowths which seem to me suggestive of sarcoma. I will not say much here about animal inoculations, because I am not so sure of my ground and, further, because I have not obtained large and striking growths of the inoculated animals, such as I did in my control plants. In fact, I was so much discouraged with the result of my first inoculations on brook trout made now five years ago, that I contented myself with simply fixing the material, and did not have any sections cut from it for nearly two years. It then occurred to me that while I had not obtained striking growths in the fish, the sections might give some helpful indications. Sections were, therefore, cut from a number of inoculated fish, and while many of them showed what I took to be inflammation only, others gave indications of what seemed to me to be the beginnings of sarcoma. I was interested enough in the matter to repeat the experiment in 1912-13, and again obtained what I take to be substitution of connective tissue cells for muscle-fibre in various inoculated fish, but, again, no well-developed tumours, only small nodules."

The trout, inoculated by Dr. Smith with cultures of *Bacterium tumefaciens* in the eye-socket, developed several times small nodular growths in the eye-muscles and elsewhere, but died before it could be determined whether these growths were really malignant neoplasms. Usually the inoculated fish died of septicæmia due to the inoculated bacteria. In one instance a practically pure culture of *Bacterium tumefaciens* was plated from the dorsal aorta of an inoculated trout and crown-gall was reproduced in sugar-beets with subcultures from its colonies.

In 1915, Friedman, Bendix, Hassal and Magnus claimed to have discovered *Bacterium tumefaciens* in man, associated with various morbid conditions such as intestinal ulcerations, purulent meningitis and synovitis. By means of this organism, isolated from human fæces, they were able to produce typical, rapidly-growing tumours in plants (*Pelargonium*).

Quite recently (1925), Professor Ferdinand Blumenthal, Director of the Cancer Laboratories of the great Charity Hospital, in Berlin, and his assistants, Dr. Hans Auler and Fraulein Paula Meyer, have claimed the discovery of *Bacterium tumefaciens* in human cancer. On examining the juice extracted from a breast carcinoma, Paula Meyer found a rod-shaped organism which proved to be *Bacterium tumefaciens*, not only on account of its morphological and cultural characters, but also because, inoculated into sun-flower plants, it gave rise to typical crown-gall overgrowths.

In consequence of this unexpected finding, thirty malignant neoplasms of various kinds (sarcoma, carcinoma) were examined and *Bacterium tumefaciens*, or some (one or several) closely related organisms, found in twelve of them (8 carcinomas, 2 sarcomas, 2 cancroids). Pure cultures, when obtainable, were inoculated into laboratory rats, mice and guinea-pigs; they gave rise to new growths which attained the size of a small pea, then receded; they could not be grafted. Further inoculations of the organism, mixed with sterile diatomaceous earth, as an irritant, and with lymph from the "brawny arm" of a patient suffering from breast-carcinoma, yielded more definite results; the new growths reached the size of beans in mice and rats, that of small cherries in guinea-pigs; they proved more persistent, formed metastases and were transplantable. Histologically, the inoculation growths were, for the most part, mixed tumours, but the transplants resembled more and more the well known sarcomas and carcinomas of mice and rats.

The said bacteria were only found at the periphery of soft, opened human tumours, never in hard, closed ones; they could not be demonstrated in the new growths experimentally produced by inoculation, and were never found either in metastases or transplants.

Since *Bacterium tumefaciens* has been found in association with metastasizing tumours, not only in the most diverse plants, but also in animals and man, it becomes imperative that we should understand the nature of the association and the mode of action of the bacterium, if any, in producing overgrowths.

In the first place, we should know the exact location of the organism within the tumour tissues. Unfortunately opinion varies considerably on this point. Cavara (1897) found the specific organism scattered through the vessels and tissues of the cortex in the smaller and younger growths. "They do not form distinct foci," says he, "but are found scattered here and there in the various tissues."

Recently (1923) A. J. Riker made an effort to locate the organism in the tissues He studied crown-gall in the tomato plant, examined the tissues at different stages of gall-formation and scrutinized the secondary as well as primary growths. "The evidence," he says, "seemed to indicate that the organism was living between the cells of the host. Its intercellular position and its scarcity apparently contributed to the difficulty of demonstrating it in the tissues. Under certain conditions the organism was found to travel through the vascular bundle. This resembles a method of distribution of cancer in animals."

Wilfrid Robinson and H. Walkdern, in "A Critical Study of Crown-gall" (1923), state that they were "able to demonstrate conclusively zoogloea strands of *Bacterium tumefaciens* along intercellular spaces and protoxylem vessels forming

centres for pathological disturbance and gall production along the tract."

Dr. Erwin F. Smith, on the other hand, has repeatedly asserted that the bacterium is not found either in vessels or intercellular spaces, and therefore must lie concealed within the granular, deep-staining cytoplasm of the tumour cells; there are no indications of its presence inside the nucleus.

In 1913, he says:—

"One of the most difficult features of the investigation has been the demonstration of the micro-organism in the tumour tissues by means of stains. For many years we have known that it was present there, because we could isolate it therefrom by the poured-plate method, but when we undertook to stain it in the tissues we discovered that it would not stain by Gram, that it was not acid-fast, and that when it did stain the protoplasm of the cell also stained, and such numerous and various granules appeared in the microscopic picture that we could not be certain whether the few rod-shaped bodies which we saw within the cells were actually bacteria or only normal constituents or degenerations of the cell contents. Very many attempts were made to counterstain the organism, so that we could differentiate it sharply. We knew that it must be within the cells, because the intercellular spaces are free not only from bacteria, but from granules of any sort, and also because the vessels are free. Assuming it to be of a size within the limits of microscopic vision, and its size on culture media seems to point to that conclusion, the only place where it could be was inside the cell. A great variety of aniline stains and various preliminary methods of fixing the tissues were tried without success. . . . Finally, I decided to abandon the aniline stains and try other methods, using salts of the heavy metals. We first tried impregnation with nitrate of silver, but without satisfactory results. Finally, however, with gold chloride, we obtained clear pictures of the micro-organism inside of the cells. . . . By this method they have been demonstrated beyond question within certain of the tumour cells and have been photographed. . . .

"It turns out that the organism is not very abundant in the cells, and is restricted, it would seem, to a small proportion of the total number of the cells forming the tumour. Its morphology within the cell is essentially that of the same organism grown in pure cultures under somewhat abnormal conditions, that is, under such conditions as lead, in tube cultures or flask cultures, to the production of club-shaped and Y-shaped or branched involution forms."

Three years later (April, 1916) he writes:—

"I cannot now say unqualifiedly that I have ever seen the organism within the cells. At times I have thought so, but I am now again in doubt. I have seen under very high powers of the microscope in fresh sections occasional rod-shaped bodies moving slowly within the cells. All attempts at differential staining by means of aniline dyes have failed, in spite of repeated trials. Subsequently, by means of gold chloride, we stained within certain of the tumour cells rod-shaped bodies which I interpreted, perhaps prematurely, as the bacteria. They agree in form and even show branching rods, but nevertheless may be normal organs of the cell. For the present then we have to depend on culture methods and on diffusion methods for demonstration of the presence of the bacteria in the tumours."

Club-shaped, Y-shaped and variously branched involution forms, similar to the bacteroids of the root-nodule bacteria of legumes, can be produced at will in cultures of *Bacterium tumefaciens* by subjecting them to unfavourable conditions such as cold, excess of sodium chloride, the action of a dilute acid or of an assimilable sugar. Poured-plates made from cultures so treated show that the majority of the organisms are dead, while the remainder are in a torpid, benumbed condition and, therefore, develop slowly in plates, just as they ordinarily do when taken directly from the tumours.

"It took us, I am ashamed to admit, about two years," says Dr. Smith, "to learn that if we would obtain cultures of *Bacterium tumefaciens* on agar-poured plates, we must not only inoculate heavily, but we must wait for a period of more than four days. Usually it requires five to seven days, sometimes ten days, and occasionally fifteen to twenty days for the benumbed organism to recover its normal morphology and vigour and develop in the form of colonies. . . . Since these facts were brought into clear light, it has been easy for us to obtain the organism from young tumours and to reproduce the disease in plants . . . That there is a numbing of the bacterium in the plant, which proceeds as far as death in many instances, is shown by the fact that at no given period are there any great number of living organisms in a given bit of tissue, and often in old tissues none whatever, as demonstrated by the poured-plate method."

Dr. Smith is inclined to give considerable importance to these involution forms in the genesis of the tumour.

"My hypothesis of the tumour-development," says he "is as follows: The micro-organism entering the cells as the result of slight wounds grows rapidly for a time. Its growth is then inhibited, apparently by its own by-products, of which one is an acid (at least in flask cultures). As the result of this inhibition many of the bacterial rods swell, becoming clumpy and variously branched, giving rise to the so-called Y-bodies. There then ensues death for many, and a dormant period for the remainder. The organisms which are killed outright, by the by-products evolved during their previous growth in the cell, are the ones which now stimulate the nucleus to development. This I conceive to take place by endotoxins or other substances, which can now pass readily through the dead walls of the bacteria and into the cell cavity to stimulate the nucleus. As soon as the nucleus begins to divide, its membrane disappears, and its contents (presumably alkaline) flow into the cell. As the result of this nuclear contents pouring into the cell, and commingling with the benumbed bacteria, they take on a new growth, pass over into the daughter-cells, and there grow rapidly for a short time, whereupon they are again inhibited with the production of the aforesaid involution forms. The nucleus in the daughter-cells now divides, and the process is repeated indefinitely."

With the help of the expert chemists (Alsberg, Brewster and Woodward) of the United States Department of Agriculture, Dr. Smith endeavoured to determine what chemical substance, resulting from the metabolism of *Bacterium tumefaciens*, might be the direct exciting cause of the abnormal cell-proliferation in crown-gall. Flask cultures were prepared with different strains of *Bacterium tumefaciens* (from Paris daisy, hop, rose, poplar) inoculated on a simple culture medium made of substances (water, peptone, grape sugar and calcium carbonate) approximating those naturally occurring in plant cells. Other flasks, containing the same medium, were held uninoculated for control. Before turning the flasks over to the chemist, Petri-dish agar plates were poured from each inoculated flask to ascertain whether the cultures continued pure, then subcultures from each were inoculated into susceptible plants to determine whether they were still pathogenic. Thus various flasks were tested and

worked up separately, with, in the main, concordant results.

The chemical analyses disclosed the following bacterial products: ammonia, amines, aldehyde, alcohol, acetone, acetic and formic acids, to which Smith adds, inferentially, carbonic acid. All of them are substances which pass readily through protoplasmic membranes, and Smith points out that the majority are "just those compounds found by Loeb and others to be most efficient in starting the development of unfertilized sea-urchins' eggs," a fact "not only astonishing, but extremely suggestive."

Experimenting with each one of these substances (first water dilutions painted on or injected, later their vapours) on several plants subject to crown-gall (ricinus, cauliflower, tomato), but in the absence of bacteria, Dr. Smith obtained decided overgrowths which he looks upon as "incipient crown-gall."

"The overgrowths are small," he says, "as was to be expected from the application of a single slight stimulus. They do not continue to grow because they are the response to an abnormal outside influence of very limited duration, or, to put it in another way, because there is no parasitic organism back of the growth, as in the case of the natural crown-gall, continually to stimulate it by means of its excretions.

"These tumours are either vascularized hyperplasias, mixed hypertrophy and hyperplasia, or simple hypertrophies. In them the cells are much more closely compacted than the parent cells and free from chlorophyll. The cells of the hypertrophies are frequently a hundred times the volume of the cells from which they have originated. In the acetic alcohol tumours there has been a great increase in the number of the cells, i.e., the development of a true hyperplasia, while in the hypertrophies the component cells appear to be the original cells greatly enlarged.

"Curious vascular displacements and duplications have also been obtained, including, in one instance, an entire extra vascular cylinder in the pith of ricinus."

Further experiments with various salts of ammonia, with dilutions of their acid compounds and with various foods and poisons also yielded similar growths.

In detailing these experiments in a paper on "Mechanism of Tumour Growth in Crown-gall," published in the *Journal of Agricultural Research*, Washington, January, 1917, Dr. Smith expresses his views on the causation of crown-gall. He says:—

"The ultimate cause of cell proliferation in crown-gall is the schizomycete *Bacterium tumefaciens* Sm. and T., but the mere mechanical irritation due to the presence of a few rod-shaped bacteria in the tissues cannot be the direct cause of the proliferation, since other species of bacteria either have no specific action when inoculated into plants or some quite different action. . . . The immediate or proximate cause of the abnormal proliferation must be the chemical or physical action of enzymes or other substances produced or activated by the bacteria as a result of their metabolism, with a corresponding reaction on the part of the plant. . . .

"At first I conceived of the crown-gall phenomenon as much more complex than it really is. I thought of endotoxins and other complex substances of unknown chemical structure as probably the cause of the excessive cell proliferation, not, however, entirely excluding simpler substances, such as ammonia compounds. . . .

"In the beginning I had what I now believe to be a wrong conception of growth. I looked upon it as something that an outside substance could directly stimulate into development, but probably it is not that (Weigert, Ribbert, Loeb). Growth is the normal function of cells. They are always multiplying when they are not inhibited by one thing or another; growth, then, if this view is correct, comes about not by the direct application of stimuli, but indirectly *by the removal of various inhibitions*. . . .

"As I now see it, tumour growth is not at all a chemical phenomenon, but rather a purely physical one, a matter of varying molecular vibrations, a development dependent on locally increased osmotic pressures which cause a movement of water and foodstuffs into the affected area. In crown-galls the removal of growth inhibitions is brought about, I think, by the physical action of substances liberated within the tumour cells as the result of the metabolism of the imprisoned bacteria. . . .

"If the cell proliferation in crown-gall is due to substances liberated within the cell by the parasite, as it seems reasonable to suppose, they must be substances either identical with or at least not differing greatly in their physical or physiological action from those acting on the non-parasitized cell during normal growth and division. Of this there can be little doubt for several reasons, and especially for the reason that there is no evidence of chemical injury either in the tissues surrounding a crown-gall or in the tumour cells themselves, since they grow and multiply with a rapidity only to be compared with that of the cells of normal young tissues. This at once removes from consideration all actively poisonous (killing) substances and greatly simplifies the problem. . .

"On the start, it seemed to me probable that ammonia given off in small quantities within the cell by the multiplying bacteria must be the sole determining factor in the abnormal cell proliferation, since as a diffusible stimulant it would enter cells readily, would increase the osmotic pressure, and would tend to enter into soapy combinations with the lipoids of the cell surface, thus changing the surface tension beyond the point of physiological cell restraint, whereupon cell division would take place. . . .

"Consequently, without entering into further details, I will say that I think I have established my original hypothesis—viz., that dilute ammonia causes intumescences and renders it probable that ammonia, liberated within the cell in small quantities by the imprisoned bacteria, must be one of the causes of the excessive and abnormal cell proliferation in crown-gall. Probably amin compounds also help to determine it. Since an acid and an alcohol are likewise produced by the crown-gall bacteria, and this alcohol and this acid (as well as many other acids) in pure dilution and also in combination with ammonia caused galls or intumescences in my experiments, the acid (or acids), the alkalies, and the alcohol must, I believe, act together in producing the tumours, and *osmotically rather than chemically*.

"To conclude, it would seem, therefore, that in local osmotic action (possibly in some stages chemical action also) of various substances (aldehyde, acetone, alcohol, acids, alkalies) thrown into cells and diffusing from them in various directions, as the result of the metabolism of a feeble intracellular parasite or symbiont, together with the resultant counter movements of water and food supply, we have, in crown-gall at least, and presumptively also in animal neoplasms, the explanation of tumour growth—that is, of that extensive multiplication of cells in opposition to physiological control which has so long puzzled pathologists and all students of overgrowths."

Whatever may be the ultimate result of the investigations on crown-gall made at the Bureau of Plant Industry, U.S. Department of Agriculture, by Dr. Erwin F. Smith and his colleagues (Brown, Townsend and McCulloch), certainly they have advanced knowledge in plant pathology and have

brought to the elucidation of the cancer problem a most valuable contribution.

Dr. Smith was the first to call attention to the striking similarity existing between crown-gall and malignant animal tumours; together with Townsend he confirmed and extended Cavara's findings, isolated the incriminated schizomycete from overgrowths in the most diverse plants and gave it the name of *Bacterium tumefaciens*. He pointed out that this organism could give rise in plants to neoplasms comparable to the various forms of cancer known in man, from a plain connective tissue hyperplasia (sarcoma) to a solid embryoma, the differences between the various types of tumours being due to unlike reactions of the different tissues. He showed that the plant overgrowths give rise to secondary tumours, usually repeating the structure of the mother tumours from which they arise by permeation in the form of long strands of infected cells. Finally, suspecting the sameness of cancer in plants, animals and man, he started experiments by inoculating the crown-gall organism in cold-blooded animals and succeeded in obtaining the formation of suggestive growths in brook trout.

The experimental production of teratomata by the inoculation of *Bacterium tumefaciens* in the leaves and internodes of susceptible plants certainly is an achievement of considerable oncological and biological interest.

Oncologically it is of importance:—

(1) Because, as Dr. Smith has shown, teratoid tumours in plants are made up of cancer cells dragging with them in their crazy proliferation, fragments of leafy shoots, abortive roots and flower buds stimulated into being, twisted, broken, jumbled, engulfed.

(2) Because these plant teratoids, being essentially like the so-called "atypical teratomata" of animals and man, suggest for the latter a like origin.

(3) Because they deal a deadly blow to Cohnheim's theory of embryonic remains since, by means of infected needle-pricks, teratoid tumours may be obtained from ordinary meristem cells in the middle of young leaves where no dormant buds are known to exist. "Seven teratoid tumours obtained from the blade of a single leaf, twenty-seven from the leaves of a single plant, surely are too many to be due to dislocated 'cell-rests'!"

Biologically it is no less important, because it contradicts Weismann's speculative theory of germ-plasm and somatic or body-plasm, and shows that young somatic cells in any part of the body may produce all of the organs and tissues of the entire plant including germ-plasm. Obviously, either each body-cell has retained its potential quota of hereditary characters or portions of the germ-plasm are widely distributed through the tissues of the plant. That a similar capacity for regeneration exists also in some degree in the somatic cells of animals has been known since Abraham Trembley made his experiments with Hydra in 1741.

Fully recognizing the importance of Dr. Erwin Smith's work on crown-gall, I must say that I do not believe *Bacterium tumefaciens* to be the essential cause of plant cancer, though, certainly, it appears to be an important factor in bringing about the overgrowth.

In the first place, *Bacterium tumefaciens* is not an endocellular organism, as, necessarily, it would be, if it were the cancer parasite. At one time, Smith did think that "it must lie concealed within the cytoplasm of the tumour-cells," because he had failed to detect it in the intercellular spaces and vessels. Indeed, he thought he had succeeded in staining it with gold chloride and even stated that he had photographed it within its cell-host, but he soon recognized and acknowledged his error, pointing out that the few rod-shaped structures he had mistaken for bacteria were probably degeneration products of the cell contents or mitochondria.[1]

Recent investigations have confirmed Cavara's early observations and we know that, as stated by him, the organism is "scattered through the various tissues and vessels, in the smaller and younger growths." Yet it is difficult to detect on account of its scarcity, its intercellular position and the fact that it is not found in the interior, but only at the periphery of young tumours. Already Virchow had shown that, in human cancer, the periphery is the youngest part of the growth and taught that one must study the outer parts of tumours to understand their development. Moreover, he had said: "A pathological tumour in man forms in exactly the same way as does a swelling on a tree, whether on the bark, on the surface of the trunk or on a leaf, wherever any pathogenic irritation has occurred.

In the tumour tissues, according to Smith, "*Bacterium tumefaciens* occurs only in small numbers in a live and cultivable state" and the surviving organisms are "in a torpid, benumbed condition, so that they will not immediately grow upon transfer to culture media." They are swollen, variously branched, many club-shaped or Y-shaped, just like the involution forms of the root-nodule bacteria. A few dying bacteria hardly seem capable of producing that sudden, rapid and intense hyperplasia which is characteristic of malignant neoplasms. Indeed, Smith himself admits that "the mere mechanical irritation, due to the presence of a few rod-shaped bacteria in the tissue, cannot be the direct cause of proliferation since other species of bacteria either have no specific action when inoculated into plants, or some quite different action." He argues, therefore, that the cause of the cell-proliferation must be the chemical or physical action of endotoxins, enzymes or other substances produced as a result of metabolism and released at death.

"Furthermore," says he, "we must assume

[1] No doubt they were rod-shaped mitochondria (chondriconts), bacteria-like bodies looked upon as organs of elaboration, yet not formed out of the cytoplasm, but invariably derived from pre-existing mitochondria by division.

either that *Bacterium tumefaciens* is frequently accompanied by, or even supplanted by, another organism indistinguishable from it on agar-poured-plates and on other media, or else that some of its own elements within the tumour have lost all pathogenic power, as shown by our inoculations, while retaining the power to grow with the proper appearance on media."

This apparent occasional loss of pathogenic power strongly suggests some associated organism, not, however, indistinguishable from it, as conjectured by Dr. Smith, but very different and probably extremely minute. Besides, the failure to find *Bacterium tumefaciens* in hypertrophied or hyperplastic tissues surrounding crown-gall overgrowths and its absence from metastases and transplants of mouse and rat tumours obtained through the inoculation of strains of *Bacterium tumefaciens* isolated from human malignant neoplasms, render the acceptance of this organism as the true cause of cancer inadmissible. Yet, *Bacterium tumefaciens* seems to play a very important part in the incidence of crown-gall by favouring in some way or other the as yet unknown specific germ.

"Invisum Pecus," The Infinitely Minute.

In Strasbourg, the year before last, Professor Borrel showed me a flea the body of which was covered by tiny mites. The flea was a female specimen of *Ceratophyllus fasciatus*, obtained from the back of a laboratory mouse undergoing the tarring process. The mites were specimens of a *Tyroglyphus* in the curious *Hypopus* stage, during which, without functional mouth parts, but heavily cui-

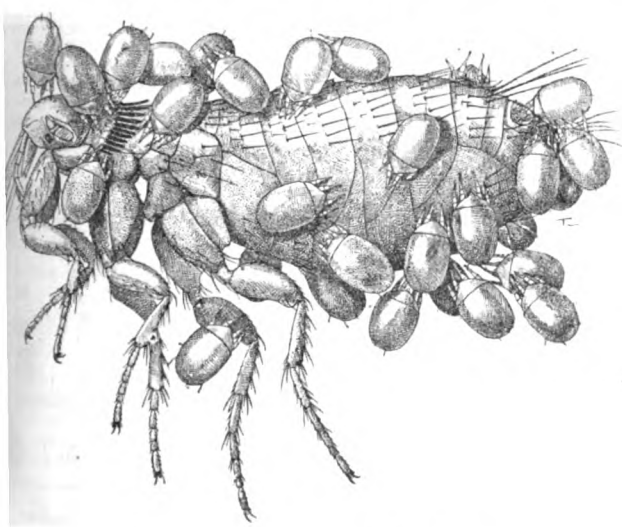


Fig. 53.—Rat flea covered with mites.

rassed and provided with ventral suckers, they attach themselves to beetles, flies, bees or other insects, merely to be transported, bur-like, from one place to another, just as occasionally do the head-louse and the book-scorpion (*Chelifer cancroides*), described by Aristotle as a tiny tailless scorpion.

The great Dutch naturalist and microscopist, Anton van Leeuwenhoek, was the first to observe the cheese or flour-mite riding upon fleas, and it was his observation which suggested the well-known lines of Swift—

> "Hobbes clearly proves that every creature
> Lives in a state of war by nature;
> So naturalists observe a flea
> Has smaller fleas that on him prey,
> And these have smaller still to bite 'em,
> And so proceed ad infinitum."

Even organisms consisting of one single cell are parasitised by smaller living things. Thus various Ciliates, such as *Paramecium*, *Stentor* and *Stylonichia*, often become the hosts of *Sphærophrya*, an endoparasitic Suctorian.

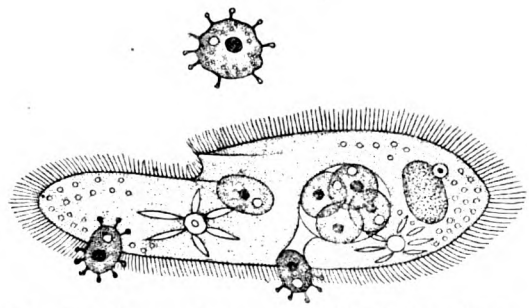


Fig. 54.—*Paramecium* parasitized by *Sphærophyra.*

Amœba proteus, the most familiar of Protozoa, and other unicellular fresh-water organisms are attacked by a smaller one-celled animal called *Nucleophaga*, because it penetrates the host's nucleus and grows and sporulates within. The infested nucleus becomes greatly hypertrophied with the growth of the parasite and, finally, the spores escape through rupture of the nuclear membrane.

Like Protozoa, so also bacteria have their parasites, messmates and symbionts and, no doubt,



Fig. 55.—Ross's "black spores."

D'Hérelle's "bactériophage" is a true parasite of Shiga's *Bacterium dysenteriæ*. It is a filter passer, as yet invisible, but fully demonstrable since it can be isolated, cultivated, and transmitted just like other parasitic microbes.

In 1900, whilst carrying out experiments and researches in the Roman Campagna, on behalf of the Colonial Office and the London School of Tropical Medicine, in order to provide irrefutable proof of the truth of the mosquito-malaria theory, I came across the "black spores" or "brown-bodies" believed by Ross to be

a kind of " enduring stage " of the malaria parasite. I found them not only in the oöcysts of *Plasmodium vivax* undergoing sporogony in the stomach wall of *Anopheles maculipennis*, but also on larvæ of *Dirofilaria immitis* developing within the Malpighian tubes of mosquitoes of the same species, and I discovered that, far from being a quiescent stage of the *Plasmodium*, or any part of its developmental cycle, Ross' " brown bodies " were its deadliest foes. They were hyperparasites of Anopheles, i.e., parasites of the " Cruel Filaria " and of the malaria parasite, both of which make use of *Anopheles maculipennis* as a necessary alternative host in their cyclical development.

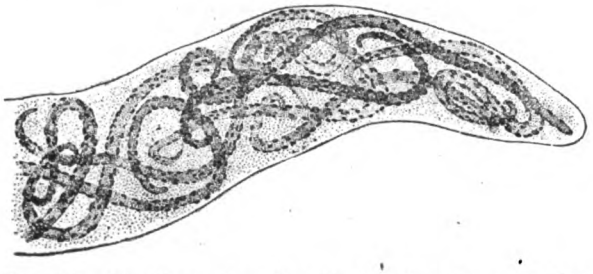


FIG. 56.—*Dirofilaria immitis* attacked by microsporidian within Malpighian tubes of *Anopheles maculipennis*.

A well-known instance of hyperparasitism is that of the Ichneumon flies. The parasitic larvæ of these Hymenoptera exercise a constant check upon the increase of moth and butterfly larvæ, of plant-lice (*Aphidæ*) and other insects injurious to plants, but they are themselves kept within bounds by hyperparasites, often of the same family, which detect at once a " stung " aphide or caterpillar and deposit their eggs in the body of the internal parasite. The larvæ hatched out of these eggs may also be attacked by smaller parasites, whose offspring in turn may suffer in like manner, the parasite being, possibly, some unicellular organism such as *Nosema ichneumonis*. It is a wonderful process carried on indefinitely far beyond our powers of investigation, and of which those " nested " Chinese boxes, which are enclosed one within another, are an apt illustration.

A knowledge of hyperparasitism has proved invaluable to agriculturists, and no doubt, in the future, it will prove of equal value to the sanitarian. Indeed, in the age of the great Oriental and Mediterranean civilizations, it was by pitting natural enemies against the fosterers and disseminators of disease germs that man conquered some of the more formidable of disease scourges, such as plague, malaria, hook-worm disease and endemic hæmaturia.

Vaccination still performed as in the days of Susruta; setons and issues still used as in the days of Galen, in ignorance, however, of their object: the pitting of pyogenic cocci against the plague bacterium; girdle, necklace, amulets and encolpia still worn, though no longer bearing insecticides against typhus-louse and plague-flea; consecration of cat, ichneumon, kestrel and rat-snake, nay, even deadly cobra, because destroyers of plague-carrying murines; domestication of snail-eating Ibis (*Ibis æthiopica*) against snail-fostered blood-fluke; protection of pellet-rolling dung-beetle (*Ateuchus sacer*) as a means of prevention against hook-worm disease; close-meshed cotton-net, gold-fish, duck, drain-pipe and smudge against plasmodium-bearing mosquitoes; loaf well raised with beer yeast; straw-covered wine-flask still holding an oil seal in its long, narrow gullet; Good Samaritan's oil-and-wine salve, testify not only to a knowledge of micro-organisms, but further to the judicious and salutary application of a knowledge which goes back to times prehistoric.

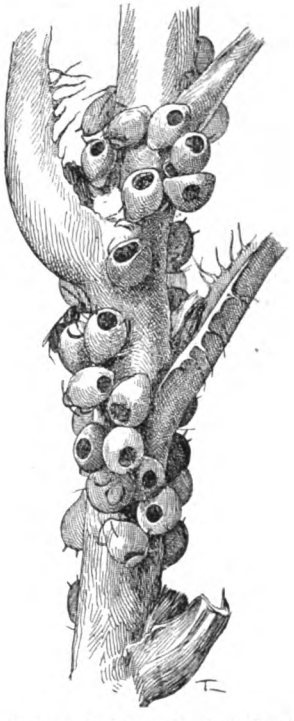


FIG. 57.—Dry, distended skins of plant-lice still clinging to black-currant stem and out of which have emerged *Ichneumonids* by cutting circular lids in the dorsal wall of their host's abdomen in the interior of which they have hatched, grown and pupated. (Original.)

Although the belief in micro-organisms as factors in the causation of fermentation and disease belongs to a very remote past, there can be no doubt that bacteriology is a comparatively new science. It sprang out of the remarkable observations of Leeuwenhoek, the true " Father of microscopy," who, with an instrument of his own construction (150 diameters against our 3,000), discovered, described and figured bacteria in 1683.[1]

I am glad that my medical studies began in the

[1] That lenses of different kinds were used in the remote past is obvious, when we consider that the Ancients were cognisant of many things which could not have been discovered without such aid.

Democritus (c 460-357 B.C.) knew the mountains and craters of the moon; to him the Galaxy, or milky river which foams athwart the sky, had resolved itself into countless stars. Aristotle (384-322 B.C.) knew the most minute structures of insects and mentions the skin-burrowing acarus (*Sarcoptes scabiei*) which, notwithstanding repeated rediscovery by Avenzoar, Redi, Wickmann and others, was unknown to the dermatologists of the XIXth century. Pliny, Ælian and Cicero describe the wonderfully minute carvings of Myrmecides, such as the ivory quadriga, with prancing horses and urging

very heyday of bacteriology, when discoveries of important pathogenic bacteria such as those of leprosy, typhoid fever, glanders, cholera, diphtheria, pneumonia, tetanus, tuberculosis and Wakker's hyacinth disease followed one another in rapid succession, because they impressed upon the mind the essentialness of a specific "contagium vivum" in all diseases.

The triumphs of bacteriology were closely followed by those of protozoology, especially in tropical pathology, Laveran leading the way with his discovery of the malaria parasite.

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charioteer, that could find cover beneath the wing of a common house-fly.

Among the glyptic treasures of our museums are many examples of amazingly minute workmanship which could neither have been executed nor clearly seen and appreciated without magnifying glasses.

Moreover, have we not found ancient mirrors, plane, concave and convexed, made by Egyptians, Hebrews, Phœnicians, Greeks, Etruscans, Romans, Celts, Chinese, Mexicans and Peruvians? We have heard of burning glasses used from time immemorial, in both the old and the new world, to rekindle sacred fires. Several ancient authors, and among them Galen, state that at the siege of Syracuse (214-212 B.C.), Archimedes, the greatest mathematician and engineer of antiquity, burnt Roman galleys out at sea by the use of powerful mirrors. This seemed incredible, yet the famous Jesuit Athanasius Kircher, and, a century later, Georges-Louis Leclerc, Comte de Buffon, proved by actual experiment that it was possible.

The magnifying power of globular glass-vessels (*pila vitrea*), filled with water, was well known to the Ancients. Macrobius tells us how the inn-keepers of his day (5th century) used to display at the tavern door eggs, tripe, vegetables and fruit immersed in water contained in spherical glass vessels, in order that their comestibles might appear larger and more alluring. Seneca, explaining the formation of the rainbow in his "Questiones Naturales," says: "Every object much exceeds its natural size when seen through water. Letters, however small and indistinct, appear larger and more distinct when seen through a glass globe filled with water." Pliny, having mentioned the burning of cloth by means of a glass globe, adds: "Surgeons who have to cauterize certain parts of the body state that the most practical way is by using a crystal globe exposed to the sun's rays."

Well do I remember, as a child, seeing in Naples oranges, eggs, russet apples and sweet fennel in large water-filled glass globes at the show-windows of eating-houses, and cobblers working out in the streets at night with water-filled flasks on their benches to serve as light condensers in front of their wick-and-oil lamps.

It was by means of a small glass sphere placed against a hole in a thin metal plate, like a crystalline lens against its iris, that Robert Hooke, in 1663, examined the structure of a thin section of cork, discovered that plant tissues are made of a congeries of "little boxes or cells," and gave us the cell theory.

Simple microscopes, thus made from glass spherules or double convex lenses, are of very ancient design, no doubt suggested by the almost spherical or more or less flattened crystalline lenses found in the eyes of fishes, birds and mammals used as food. Indeed, all man's inventions have been judiciously borrowed from Nature. Porta's "Camera Obscura," now turned into our photographic camera, what else is it but the copy of the eye, a gigantic eye?

In the British Museum is an oval piece of rock-crystal, the size of a modern spectacle lens, cut and ground to a plano-convex form, which was found by Mr. Layard during the excavations of Sargon's Palace at Nimrud. This dates back to the seventh century B.C. and Sir David Brewster pronounced it to be a lens designed for the purpose of magnifying, but his authoritative opinion was discredited. However, other similar lenses were soon found at Pompeii, Herculaneum and Nola, and others again quite recently in Asia Minor. All of these are undoubtedly magnifying glasses.

Rock-crystal balls were made and used even for "scrying" long before our era. Many of these must have fallen and, breaking in the plane of cleavage, produced plano-convex lenses. Is it possible that the lapidary picking up the fragment, noticing its magnifying properties, never even thought of useful applications?

That Aristotle used a simple microscope, like that of Leeuwenhoek, is more than probable, but even combinations of lenses affixed to tubes may have been used. The lack of any actual description of such instruments in extant ancient literature is of little import. What shou'd we know of Etruscan dentistry had we not found in the ancient tombs of Corneto Tarquinia the very dentures with artificial teeth shaped from the lacteal incisors of cattle and held in position by perfect gold attachments—the very bridge-work of modern American dentistry? And what should we know of Greco-Roman catheters and trocars, of oral, rectal and vaginal specula, had we not found these instruments preserved beneath the volcanic dust blown out of the Vesuvian crater in its mighty explosive eruption of A.D. 79?

Truly we know nothing of the invention of either microscope or telescope. Authors, copying one another, usually ascribe the invention of the telescope to Hans Lippershey, or Lippersheim, in the year 1606 or 1608, stating, at the same time, that this man was not the inventor, since he borrowed the idea from Zacharias Jansen, adding, however, a tube. Jansen, we are told, was a Middelburg spectacle-maker. His children, while at play, happened to place two of his lenses, one behind the other, and were surprised to see the familiar weather-cock of the church opposite their house bow, grow larger and appear to approach them, with its lettered perch, when viewed through the combined glasses. Called to see the portent Jansen fixed the glasses on to an ornate board, and presented them, thus united, as a toy or "wonder" to "Prince" (Count) Maurice of Nassau who, being born in June, 1604, was either 2 or 4 years old at the time.

Govi ascribes the invention of the telescope to Galileo; others state that in 1609, having heard of Lippersheim's instrument, Galileo sat up all night and made a telescope out of an old organ pipe with a glass at each end (convex lens for objective and concave lens for eyepiece). A few years later, with an improved instrument, magnifying about thirty-three diameters, the great Italian physicist discovered Jupiter's satellites, the solar spots and the mountains and craters of the moon, but these discoveries were only rediscoveries, because, as already stated, lunar mountains, sun spots and Jovial satellites were known to the Ancients. The making of an astronomical telescope led Galileo to make a compound microscope, which likewise consists essentially of two lenses, an objective and an eyepiece, but both of short focal length. Girolamo Aleandro, writing from Rome in 1624, says that Galileo had invented an *occhiale* by means of which one could see a fly the size of a barnyard fowl. That Galileo made telescopes and microscopes there can be no doubt, but he never claimed the invention of either instrument.

Father Jean Mabillion, in his "Iter Germanicum," 1717, states that in a manscript of the thirteenth century he had found a miniature representing Ptolemy star-gazing through a very long tube. The early telescopes were all very long to insure high magnifying power and distinctness of image. Some of the telescopes of the middle of the seventeenth century were more than 200 feet in length.

Speaking of the "optic tube" as Milton called the Galilean telescope, the geographer Strabo (63 B.C.—A.D. 24) compares it to an older, more primitive telescope, possibly its prototype, the deep tubular well, in the water-mirror of which the stars can be seen at noon.

Pliny ("Nat. Hist.," Book 37, c. 15) relates that Nero watched the gladiatorial combats by means of an emerald and some authors have reasonably inferred from this statement that the emperor was short-sighted and that he corrected his myopia by making use of a concave cut emerald, but the majority of writers on the history of spectacles have repudiated this interpretation. They assume that eyeglasses were totally unknown before the thirteenth century and, therefore, conjecture that Nero merely amused himself at looking through a coloured gem, or mayhap, rested his sight thereby, because, as Pliny says: "Emeralds are the only gems which enrapture without satiating the eyes and will even soothe them when wearied by other sights. Gem engravers have no better salve for their

Now, however, like the ancients, we are ourselves surmising the existence of living organisms far smaller than any bacterium hitherto known. Ultra-microscopic organisms were first suspected in 1899, when Nocard found that the virus of cattle pleuro-pneumonia passed through bacterial filters. The number of recognized filterable viruses has grown considerably within recent years and includes the causal agents of several grave distempers. A disease of special interest to us is the common wart (*Verruca*), a filter-passer the mild contagiousness of which has been known for centuries.

At one time microbial activity was considered to be an enzymic chemical process, now we may have to look upon the enzyme as a living thing.

The analogy between enzymes and toxins is striking, and I venture to suggest that many zoo-toxins, such as snake venom, may be due to filter-passing viruses.

In the first place, it is well known that while certain snakes are harmless, others are deadly. The latter are provided with poison-glands, containing a lethal fluid, and with grooved or tubular fangs, wonderfully adapted to its inoculation. The venom-gland is a modified salivary gland, the tubular fang a modified tooth. These structural modifications, of which we find every gradation represented among the various snakes, show that venom-gland and poison-fang have gradually developed in response to some animate stimulus. Surely, it cannot be unreasonable to compare the remarkable, highly-specialized fang-mechanism of vipers and rattle-snakes with the innumerable and wondrous modifications which have taken place in the structure of flowers and insects, in adaptation to requirements necessary to ensure cross-pollination. And, certainly, we cannot overlook the striking resemblance between the grooved or tubular poison-fangs of snakes and the enlarged, hollowed and perforated thorns of species of *Acacia* tenanted by arboreal ants, which protect the host-plant against leaf-cutting myrmicines and other injurious insects.

Most suggestive is the fact that snake-venom is stored, but not necessarily elaborated, within the poison-gland. The blood of both harmless and

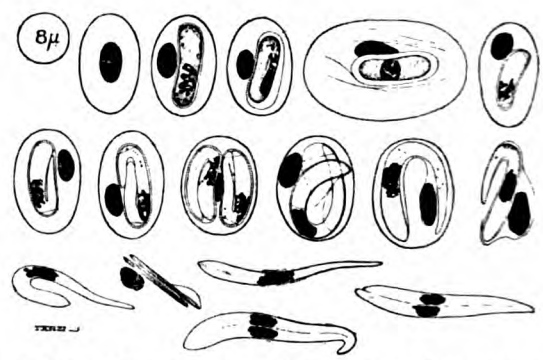


FIG. 57A.—*Hæmogregarina seligmanni* Sambon 1907, from Bushmaster (*Lachesis mutus*). Sporonts in normal-sized erythrocytes, schizonts in greatly enlarged erythrocytes. Free forms, conjugating forms and rolled up empty capsules.

venomous snakes is toxic and its toxicity is the same as that of the gland-venom, both giving rise to the same symptoms when subcutaneously or intravenously inoculated. Indeed, Calmette has shown that cobra blood-serum confers a more powerful immunity than cobra-venom. It seems, therefore, that the blood is the true habitat of the specific virus. Moreover, the same toxic agent is found in the yolk of snakes' eggs, suggesting transmission to the progeny of what appears to be a valuable symbiotic organism. Though deadly, if inoculated subcutaneously, the venom of the viper is harmless if swallowed, even in large doses, as Redi's famous experiments proved two and a half centuries ago. Another instructive fact is the seasonal variation in toxicity; the venom of *Vipera aspis*, whilst almost innocuous in the month of April, becomes powerfully toxic in May.

An example parallel to that of venomous animals is offered by luminous animals. Bioluminescence has been studied by the chemist with mortar and test-tube, and he has given us many "luminous" names, such as noctilucin, luciferin, luciferase, pre-luciferin, coluciferase, photogenin, photopelein

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eyes, because with their verdant softness they allay fatigue, besides they make it possible to use the eyes for a longer period casting by reflection their colour to all around."

I do not think there can be any doubt that Nero used his emerald or beryl (since Pliny's term smaragdus comprises both) either as a single eyeglass or as a mirror. Pliny tells us that "most emeralds were concave," we may therefore reasonably assume that the one used by the Emperor was also concave and that he used it to correct the myopia of his dull grey eyes. However, it is also possible that the stone had a flat surface and was used as a mirror. Pliny remarks that, when the surface of the smaragdus is flat, it reflects the image of objects in the same manner as a mirror and, indeed, by holding the flat surface of an emerald close to the eye, distant objects can be distinctly seen reflected on it. The great Franciscan friar, Roger Bacon, mentions how a plano-convex lens held in the hand "is useful to old men and those who have weak eyes."

It is very probable that Nero watched the games, just as another famous myope, Pope Leo X, watched, through a concave glass, hawks and eagles high up in the air, or far away in the fields, swoop to their prey.

In connection with the use of emeralds as single eyeglasses, spectacles or mirrors in the first century, it is interesting to note that beryl, a variety of emerald, was the material chiefly used in the manufacture of spectacles when, twelve centuries later, we find them common and in general use. The great French surgeon, Guy de Chauliac, writing in 1363, says: "Should these collyria fail, it will be necessary to use spectacles either of glass or beryl." Beryl was so generally employed that in France the very name of eyeglasses was "bericles," "besicles," or some other corrupt form of the term beryl. Tortelli, in his work "De Orthographia," Venice, 1471, mentions that spectacle lenses were cut of glass, crystal, or beryl.

In China the use of spectacles appears to be very ancient, for spectacles of rock-crystal and beryl are reported by the earliest travellers. Imperial Rome held commercial intercourse with China, for Florus states that Augustus received a Chinese embassy and it is possible that Chinese eyeglasses were brought over at that time. Certainly they were introduced or reintroduced into Europe in the thirteenth century by missionaries and merchants who visited China about that time. Among the latter, Marco Polo stands out a prominent, well-known figure. In any case, it is certain that Italian monks were among the first spectacle makers and that Venice long held the monopoly.

oxyluciferin, and luciferescine, but little else. With Pierantoni (1918), I am inclined to believe that the luminescence of the photogenic organs of fire-flies and other lantern-bearing animals is due to the presence of luminous symbiotic organisms. During pupation the light organ of the larval fire-fly is transformed into the new lamp of the imago, and the latter will oviposit luminous eggs. The unicellular and multicellular photogenic-glands of luminous animals contain " luciferine granules " in every way comparable to the " zymogene granules " of digestive-glands and to the " venogene granules " of venom-glands, and, no doubt, to the granules or " coccoid bodies " which, as I have shown, occur in the endocellular stage of spirochætes.

The photogenic material from luminous-glands, the rennet or other ferment from digestive-glands, the venom from poison-glands and Rous' fowl sarcoma, may be desiccated, and all will, in this state, preserve their activity, a striking characteristic action active in infinitesimal dilutions.

In my first cancer report (June 2, 1924), I said: " If it be true that the most diverse forms of irritation, animate and inanimate, may give rise to cancer, then surely the cancer germ must be some frequent and ubiquitous micro-organism, like the germ or germs which, in association with *Filaria bancrofti*, or some like factor, bring about those enormous tumour-like formations we call elephantiasis and pachydermia.

" Failure hitherto to find the cancer germ may have been due to faulty technique or to extreme minuteness. Recently, indeed, Rous and his fellow-workers have found that chicken tumours of connective tissue type may be reproduced in healthy fowls of the same breed by the injection of cell-free extracts of these tumours. In each case the neoplasm produced in the inoculated fowl resembled the tumour from which the extract was made. This shows that the type of tumour is determined by the individuality of the causative agent and not alone by the potentialities of the stimulated cells. The work of Rous and others seems to show that particular neoplasms have specific causative agents which in some cases can be separated from the neoplasm. They appear to be living ultramicroscopic organisms able to pass through a Berkefeld filter impermeable to *Bacillus fluorescens liquifaciens*. Already several diseases have been shown to be due to so-called filtrable viruses."

In my second report (February, 1925), I said: " Whatever be the rôle of parasitic worms, the actual essential cause of cancer is some ubiquitous micro-organism, probably a filter-passer, as the researches of Rous and his fellow-workers seem to indicate, but this parasite, apparently, is unable to thrive except in tissues of low or lowered resistance. We see it therefore affect embryonic residues, pigmentary moles, burn scars, goitrous thyroids, breast adenomas, the margin of gastric ulcers, the lesions of dysentery, syphilis and tuberculosis, as well as those caused by the irritation of foreign bodies or by the parasitism of helminths."

These views were soon supported by Dr. W. E. Gye's " Researches on the Ætiology of Malignant Growths," published in the *Lancet* of July 18, 1925. Gye has not only confirmed Rous's findings, but duplicated them with mouse, rat and human malignant neoplasms which, hitherto, had not been propagated by cell filtrates. Gye's work inspires confidence; it shows consummate technical skill, great acumen and sound judgment. Gye has succeeded in isolating, incubating, and breeding a specific ultramicroscopic endocellular organism which, in nature, requires peculiar conditions of tissue irritation that it may cause overgrowths. In his experimental work (by inoculating, together with the " virus," the necessary cell-irritant extracted from tissues already cancerous) he has overcome this difficulty so successfully that he has obtained 100 per cent. of " takes." Gye has shown that the virus is not so strictly specific as formerly believed since it can be supplied by tumours of other kinds and from widely different species of animals. This, however, had already become evident when the Japanese Shirai proved that rat sarcoma could be grafted successfully upon the brain of rabbit, mouse and pigeon. The main difficulty lies not with the parasite, but with the host, and, no wonder, since the cancer germ is an endocellular organism, just like the malaria parasite and an infinity of other endocellular parasites (*Hæmogregarines*, *Leucocytozoa*, *Spirochætes*, &c.) of strict specificness, because of their restriction to particular cells such as erythrocytes, leucocytes, or vascular endothelial cells. An appropriate and cogent example is that of *Rickettsia* in typhus fever. The parasite affects almost exclusively the endothelial cells of the capillaries. The reaction to the parasite is shown by proliferation on the part of the endothelium, giving rise to characteristic intravascular nodules (" nodules " of Fraenkel) in skin and central nervous system. The virus (*Rickettsia prowazeki*) is present in the cells of the proliferative lesions and is carried into the nerve tissue by the migration of infected endothelial cells.

Remedies Old and New.

With regard to treatment, I have nothing of importance to report. Dr. C. Bakker, of Broek, North Holland, who is a keen student of folk-lore, told me that in the Netherlands the greater celandine (*Chelidonium majus*) was long considered a specific against cancer.

In Villa Lagarina, whilst inspecting the garden of one of the houses of Via Damiano Chiesa in which no less than five cancer cases had occurred, I came across a large cluster of the celandine, unmistakable in the glaucous colour of its beautiful pinnately-lobed leaves, in the bright gold of its flowers, large as buttercups. I broke some of the delicate branches to see the " Devil's milk "—its saffron-coloured latex—ooze out, and a distinguished engineer, Signor Sandona, who was showing me round, told me that in Italy also this plant is looked upon by rustics as a valuable remedy in the treatment of oral and cutaneous cancer. Certainly, with us, its

orange, acrid, caustic juice has long been used to destroy warts, as some of the plant's popular names —kill-wart, wart-weed, wart-wort, felon-wort and wart-flower—clearly indicate.

Chelidonium majus is a perennial, deciduous and herbaceous plant belonging to the poppy family; it is widely distributed throughout Eurasia, but the proximity of its stations to villages, farmhouses, ruins and cottage-hedgerows points to its use by man during long ages.

By the rule of signatures it was supposed to be intended as a remedy for the jaundice, its yellow latex corresponding with the yellow hue of the patient. For this purpose its leaves and stalks were boiled up with strawberry leaves. When given internally, in large doses, it excites violent purging. Externally the fresh latex acts as a local irritant and was used not only to destroy warts on hands and face, but also, mixed with woman's milk, to remove pannus and opacities from the cornea. Already Pliny the elder speaking of celandine or swallow-wart says: "It is by the aid of this plant that the swallow restores the sight of its fledglings in the nest, even though their eyes be plucked out!" This belief was held by Dioscorides and other earlier Greek authors, hence the ancient name of the plant derived from the Greek word chelidon, a swallow. Mixed with sulphur it was used in the treatment of scabies.

The greater celandine contains several alkaloids such as chelidonine (identical with stylophorine), chelerythrine (which is fluorescent) and protopine combined with organic acids such as chelidonic, malic, citric and tartaric. It also contains chelidoxanthin, a bitter neutral principle, possessing a yellow colour and resembling berberine.

Dr. Bonne told me that some weeks before our trip to Zeeland a local quack had been fined and imprisoned for having split open a live puppy-dog and applied it to a cancer of the breast.

The application of dogs, cats, fowls and pigeons to a diseased part of the body, split open, warm, palpitating, was a common practice throughout the middle-ages in the treatment of the most diverse diseases such as colic, pleurisy, megrim, abscess, rheumatism, gout and epilepsy. Dr. Coulon, in his "Curiosités de l'Histoire des Remèdes," 1892, quotes from a medical and pharmaceutical dictionary of the eighteenth century the following prescriptions:—

"A cat cleaved lengthwise, after decapitation, and applied whilst still warm, relieves intercostal pain.

"A black barn-fowl, split open alive and immeditely applied to the head may be of use against headache and frenzy.

"A pigeon split open and applied whilst warm and living to the shaven scalp will sooth melancholia and dissipate sadness."

Quite recently, Professor Fichera has advocated the application of fresh splenic pulp to open cancers.

In the course of my recent peregrinations, I met a physician who said the best remedy, the best preventive would be the early enforcement of euthanasia in all cases. I told him his method of treatment was no novelty. Already long ago, the Russians had, trained cannon on plague-stricken villages, forgetting the part played by rats and fleas in the dissemination of the disease. Theodore, the mad King of Abyssinia, had invited the lepers of his kingdom to a great banquet and, when strong mead had made them somnolent, he had fired the banqueting hall. Gui Patin (February 1, 1657) gives definite instructions for the treatment of patients suffering from rabies; he says: "They must be smothered in their beds with quilts and blankets, or forced to swallow a pill containing six grains of pure opium in order that nothing more need be said about them." To-day foot-and-mouth disease in cattle is being treated by wholesale slaughtering! God forbid that, in our ignorance, we should extend such methods!

Summary.

Facts Observed, Experiments Made, and Conclusions Reached.

During the last three years, whenever possible, I directed my attention and activities to the study of the natural history of cancer in different countries. In this work I was assisted by distinguished physicians and naturalists, well-known experts in their own branches of research. Thus already many facts have been examined and observations and experiments made which bring valid support to the parasitic theory of cancer and point to some microscopic or ultra-microscopic organism as the *causa causans*.

Epidemiological Investigations.

Whilst much important work has been and is being carried out by numerous investigators in hospital and laboratory, I decided to endeavour to elucidate the ætiology of cancer by a careful investigation of its endemiological and epidemiological features, studied directly in the field.

My investigations, commenced in tropical (West Indies) and arctic (Iceland) regions, have been continued, during 1925, in some of the lowlands (Holland) and mountainous districts (Eastern Alps) of the temperate zone, in country and town, among vegetarians and meat-eaters, in man, animals and plants, that the survey might be comprehensive.

The results of the recent endemiological investigations (1925) confirm and extend those previously made; they are definite and fully documented (the case-lists and distribution maps are signed and stamped by local physicians and by civil and ecclesiastical authorities); they certainly dispose of a number of groundless theories which only impeded further scientific research.

It has been ascertained that:—

(1) Cancer distribution and prevalence vary from place to place, often considerably, irrespective of climate, race, food, type of dwelling, habits and customs.

(2) The organs, or parts of the body, more frequently affected by cancer vary, not only in countries far removed from one another, but also, and often strikingly, in adjoining districts.

(3) As a rule, cancer cases are distributed in groups or clusters. A first case is usually followed by one, two, three, or more cases, either in the same house, or in adjoining, or neighbouring houses, the successive patients being sometimes related, more often not.

(4) Frequently, in a cancer cluster, all, or the majority of the patients, whether related or not, are affected in the same organ, or in the same part of the body, indicating, very probably, a common source of infection.

(5) Notwithstanding occasional increase in certain localities, decline in others, the relative frequence of regional incidence shows that same remarkable persistence which is characteristic of the "stations" of well-known endemic diseases.

(6) Notwithstanding general progressive increase or decline, cancer exhibits, in its local incidence, noticeable fluctuations from year to year, such as are witnessed in all endemic diseases.

(7) For a number of years cancer may prevail exclusively in one section of a region, town, or village, then affect some other section, whilst continuing, increasing, diminishing, or maybe even dying out in the section previously affected.

(8) Cancer may break out suddenly in a place long immune, then disappear, or it may remain quiescent, at least in so far as man is concerned, for many years.

(9) Heredity is not a determining factor. While in certain villages many family cases were investigated, in others no blood relationship whatever could be traced between any of the numerous cases which had occurred during periods of from forty to fifty years. Moreover, it was found that cancer might appear first in the children, and later, sometimes much later, in the parents, or almost simultaneously in both.

(10) The habitation of certain premises appears to be a factor of importance, at least whilst as yet undetermined cancerous conditions persist.

The term "cancer-house" may be a misnomer, but, none the less, it is certain that certain houses because of the repeated occurrence of the disease in different families inhabiting them successively, have gained an evil reputation and the popular name of "cancer houses." Irrefutable examples are mentioned. Cancer in husband and wife is frequently observed. Often a primary case is followed by malignant disease in members of the same household, not always in a blood-relative or spouse, but often in brother-in-law or sister-in-law, step-son or step-daughter, maidservant or lodger.

(11) Under the same roof, cancer in dog, cat, fowl, or other domestic animal occasionally may be found in association with cancer in man, either preceding or following it.

The Harlingen and Birmingham cases quoted seem deserving of consideration.

Parasitological Researches.

Our field investigations having shown that cancer is a place-, often a house-disease, a study of the flora and fauna of cancer-houses (houses with more than two non-related cases) and their surroundings was indicated. In the course of this work, by no means completed, several lines of investigation were and are being followed.

The Report deals with the consideration of certain helminths of animals (some occurring also in man) as possible mediate agents in the incidence of cancer. By their destructive activities these parasites often incite cell-proliferation and the lesions produced, or the reparative hyperplasia which follows, seem to be favourable factors in the development of cancer.

During recent investigations in Holland and Italy many household pests were collected, as well as parasites found in and upon domestic animals and house vermin. Of the collected material only such part as was considered to be relevant received special attention.

Among the helminths discussed are certain species or races of *Gongylonema* (*G. pulchrum*, *G. scutatum*, *G. neoplasticum*, &c.) from pigs, cattle, sheep, goats, rats and mice; *Trichosomoides crassicauda*, *Muspicea borreli*, *Heterakis isolonche*, a new species of *Hepaticola* and *Hydatigera tæniæformis*.

Incidentally, experiments were made with the cattle *Gongylonema*, its local intermediate hosts (several species of dung-beetles), and the two kinds of cockroaches (*Blatta orientalis* and *Blattella germanica*) found in the Trentino.

(1) Household insects, such as *Blatta*, *Blattella*, *Blaps*, *Tenebrio* and *Ephestia*, were not found to be infected with *Gongylonema* in Northern Italy.

(2) Four species of dung-beetles (*Onthophagus taurus*, *Caccobius schreberi*, *Aphodius hæmorrhoidalis* and *Oniticellus fulvus*) were found, in the same region, to be naturally infested with larvæ of *Gongylonema*, presumably of the cattle form (*G. scutatum*). No other natural intermediate hosts for *Gongylonema* were discovered.

(3) The German cockroach (*Blattella germanica*) was successfully infested by feeding it with the eggs of the cattle *Gongylonema* (*G. scutatum*), but several attempts to infect the larger, more common Oriental cockroach (*Blatta orientalis*) failed, though this species, like *Blattella germanica*, is known to foster the larva of the rat *Gongylonema* (*G. neoplasticum*).

(4) Rats fed on cockroaches collected in the houses of Villa Lagarina and other Trentino villages did not become infected with *Gongylonema*, a fact which confirms the negative results obtained through the laborious dissection of these cockroaches.

(5) Two sheep, two pigs and a calf of British breed were fed in London with naturally infested dung-beetles collected by Dr. Scrinzi in the neighbourhood of Villa Lagarina. The larvæ fostered by these beetles were those of the cattle form of *Gongylonema* (*G. scutatum*). Calf and sheep became heavily infested, while the pigs remained immune.

A case of *Gongylonema* infestation in the human being—a young woman of Saracinesco (Tivoli)—

reported by Professor Alessandrini of Rome in 1914, was traced, the patient and the extracted nematodes examined, the locality of infestation visited and evidence obtained which shows that the parasites extracted from the girl's mouth do not belong to a new species, as suggested by Professor Alessandrini, but are, very probably, specimens of the hog Gongylonema (*Gongylonema pulchrum*).

Of about ninety rats captured in or near Villa Lagarina (chiefly young ones) two had mammary tumours and one was affected by two neoplasms of different type: a benign fibro-adenoma of the mamma and a malignant gastric tumour. The cancerous neoplasm arose as a papillomatous growth from the cardiac portion of the stomach, which harboured specimens of *Hepaticola gastrica*, a new *species* of Trichurid worm hitherto confounded with *Hepaticola hepatica*, and described by Dr. Baylis. One, possibly two, of these nematodes and some of the extruded characteristic ova were embedded in the neoplasm.

Part Played by Helminths in the Ætiology of Cancer.

A significant example of the mediate agency played by Helminths in the production of cancer is the presence, in rats, of malignant neoplasms of different type in different organs, each associated with the helminth peculiar to that particular organ and varying in incidence in different regions with the distribution and prevalence of each helminth.

The following instances may now be cited:—

(*a*) Liver sarcoma associated with the *Strobilocercus*, or strobilate form of *Hydatigera tæniæformis* which encysts in the rat's liver (Borrel, Bridré, Bullock, Curtis, Conseil, McCoy, Regaud, Wherry, and others).

(*b*) Gastric carcinoma associated with *Gongylonema neoplasticum*, which excavates galleries in the pavimentous epithelium lining the cardiac portion of the rat's stomach (Fibiger, Wassink).

(*c*) Gastric carcinoma associated with a new species of *Hepaticola* (*H. gastrica*), which also excavates galleries in the pavimentous epithelium lining the cardiac portion of the rat's stomach (Baylis, Beatti, Bonne, Sambon, Wassink).

(*d*) Cancer of the bladder associated with *Trichosomoides crassicauda*, which in its adult stage dwells in the rat's urinary bladder (Löwenstein, Sambon, Saul, Thomas, Wassink).

The reality of this agency is confirmed by the experimental production, on a large scale, of malignant growths in the rat through the administration of the eggs of *Hydatigera tæniæformis*, or of the larvæ of *Gongylonema neoplasticum*. These experiments, many times repeated by different investigators, prove that by irritation and consequent hyperplasia, any of the various helminths mentioned, and probably others, may incite, or favour, the production of neoplasms, provided the necessary causative factor be also present, either brought in by these helminths, in their early migrations, or otherwise introduced.

In man, the presence of certain helminths, acting as living irritants in the particular organs they invariably affect, explains most satisfactorily some of the more striking differences in the body location of cancer noticed in different districts and countries inhabited by such helminths. Instructive examples are:—

(*a*) *Schistosoma hæmatobium*, associated with carcinoma of the urogenital system in Lower Egypt.

(*b*) *Schistosoma mansoni*, associated with carcinoma of the large bowel and perineum in Lower Egypt.

(*c*) *Schistosoma japonicum*, associated with hepatic cancer in the Island of Kyushu (Japan) and other low-lying parts of China and Japan.

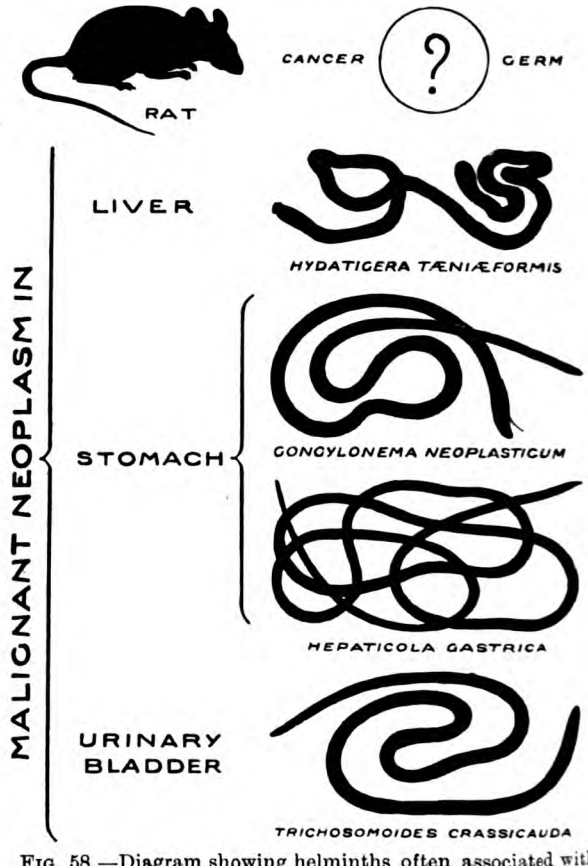


Fig. 58.—Diagram showing helminths often associated with cancer in the rat and apparently determining its visceral location.

(*d*) *Opisthorchis felineus*, associated with primary cancer of the liver on the mainland shores of the Kurisches Haff (East Prussia), in eaters of raw fish.

(*e*) *Trichinella spiralis*, *Oxyuris vermicularis*, *Clonorchis sinensis*, and other helminths associated with neoplasms in the organs they respectively affect. The agency of these latter worms, however, has not yet been substantiated definitely.

The mediate agency of various helminths in the production of cancer in man, within the organs of the body which they respectively affect, is supported by the similar, yet different, visceral distribution of

malignant growths in domestic and wild animals. The difference is in the site-incidence, which varies in the different zoological species with the variously located helminths peculiar to each species, as has been shown in the case of the rat and other animals. A singularly striking example is the occurrence of epithelioma of the lachrymal caruncle in cattle, probably incited by *Thelazia rhodesi*, a Spirurid worm which affects the excretory ducts of the lachrymal glands.

Moreover, the agency of animate irritants is paralleled by that of inanimate irritants (physical, chemical, mechanical), so universally admitted and by many considered to be the all-sufficient cause of cancer.

Recognition of the frequent, indubitable association of neoplasms with helminths or other parasites (acari, protozoa, bacteria) assumes paramount importance, when we realize that it indicates very definitely a possibility of controlling the disease in so far as it is brought about by the mediation of certain parasites, because, as is well known, the elimination of parasites and their carriers lies well within the scope and power of preventive medicine.

Plant Cancer.

In view of recent findings (Smith, Blumenthal, and others), the distribution of crown-gall (plant-cancer) was studied in its possible relationship to cancer distribution and prevalence in the Trentino, where it is well known to agriculturists, pomologists and wine-growers, who call it "gozzo" (goitre), "rogna" (scab), and "marezzo" (crispation), and occupies a range co-extensive with that of cancer. *Bacterium tumefaciens* does not seem to be the true cause of plant cancer, but it probably is of importance as an auxiliary factor.

Should the "virus" of human and animal cancer prove to be the same as that of plant cancer, as Blumenthal's experiments seem to indicate, its ubiquity would be easily understood, since crown-gall is common in the tobacco-plant, in the majority of food-plants (such as potato, cabbage, tomato, carrot, turnip, sugar-beet, radish, lettuce, apple, pear, plum, peach, cherry, raspberry, blackberry, grape, walnut, chestnut, &c.), and in many of the ornamental plants (such as rose, carnation, geranium, chrysanthemum, honeysuckle, sunflower, oleander, poplar, willow, &c.), usually introduced into our gardens and houses.

The "Virus."

The nature of the cancer "virus" is discussed. The views expressed in the two previous reports are upheld and the findings of Peyton Rous, recently confirmed and extended by Gye, are regarded as most important.

Finally, zymogen, venogen, and luciferine granules are looked upon as symbiotic organisms, the further study of which is likely to throw light on the cancer germ and other "filtrable viruses." They are comparable to the granules or "coccoid bodies" of spirochætes which may be seen in the blood-cells of their vertebrate hosts and in the body-cavity, salivary glands, ovaries, and eggs of their invertebrate hosts.

We are on the threshold of a vast world of minimal forms of life even more wonderfully and fearfully made than those which antiquity surmised and the eighteenth century revealed.



Fig. 59.—*Ceratophyllus fasciatus* with *Tyroglyphus sp.* in hypopus stage.

CANCER OF THE STOMACH OF THE WILD RAT AND INFECTION WITH A NEMATODE WORM, *HEPATICOLA GASTRICA* BAYLIS, 1925.

By C. Bonne.

In 1925 Dr. L. W. Sambon invited me to join the Cancer Field Commission of the Tropical Diseases Prevention Association on a visit to the province of Trentino in Italy. This commission, which was engaged in an epidemiological study of cancer in certain villages in the said province had its headquarters at Trento. Rats were collected in the village of Villa Lagarina, and in August, 1925, I had the opportunity of examining one of these, a freshly-killed, full-grown brown rat (*Rattus norvegicus*), body length 22 cm., with a tumour-like growth in the right mammary region, between the second and the third thoracic nipples. The skin was bulging out at this place and had lost part of its hairs. After opening the rat there appeared to be present under the skin a tumour of the size and shape of a small chestnut (fig. 27), not very hard of consistence, and rather freely movable with regard to skin and thoracic wall. The surface of the well-defined tumour was rather smooth, but a definite fibrous capsule was not recognizable. In the stomach there was a second tumour, about the size of a cherry stone or a little larger. It was a papillomatous growth in the cardiac portion of the stomach, protruding into the lumen of the organ (fig. 28). The glandular part of the stomach looked normal. In the pavimentous epithelium of the cardiac portion of the stomach, a few nematodes were lying in sinuous galleries, which were identified by Dr. Baylis, helminthologist of the British Museum, and member of the Cancer Field Commission, as *Hepaticola gastrica* (fig. 42). One of these nematodes was seen in the immediate neighbourhood of the tumour. No tumour metastases were seen in lymph glands, liver, lungs or elsewhere.

In returning to the Leeuwenhoekhuis in Amsterdam, I took with me the stomach of the rat and part of the breast tumour. Histologically the type of breast tumour was not very readily comparable to the ordinary types of human breast tumours (fig. 60). In the well-developed stroma we see groups of tubules, usually lined with a single layer of epithelial cells. The tubules are arranged in lobules as we see it in the normal mammary gland. In many of these lobules, however, there is a reduction of the epithelial part and an excess of connective tissue resembling pericanalicular fibroma in man. In other lobules there is a proliferation of the epithelial part. No definite degenerative changes or definite signs of inflammation are visible. The tumour could be classified as a fibro-adenoma of benign character. Serial celloidin sections were made of the stomach tumour and of the adjacent part of the stomach wall.

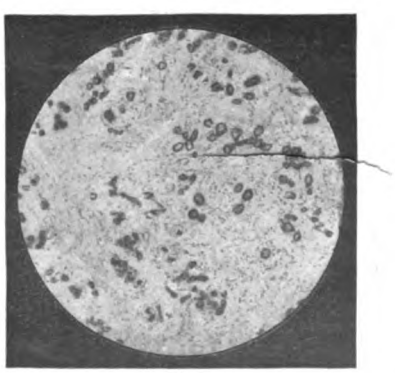


Fig. 60.—Section of rat's mammary tumour.

The sections show an enormous papillomatous growth involving the epithelium, the muscularis mucosæ and the submucosa. The muscle of the stomach wall passes beneath the tumour unmodified (fig. 61). The stem of the papilloma is very broad; wide blood-vessels are present in it. In following up the serial sections it soon becomes obvious that the tumour does not present the same character in all its parts. At a certain point the epithelium begins to grow downward into the broad stem of the papilloma, it invades the muscularis mucosæ, penetrates through it, destroys it completely and spreads in every direction, until it reaches the muscular layer. The surrounding connective tissue shows an intense infiltration with round-cells and leucocytes with a certain degree of eosinophilia. The growth of the tumour-cells in the deeper part of the stomach wall is very atypical. There is not only a definite polymorphia, but this invading part of the tumour in certain areas also entirely loses its character of stratified pavimentous epithelium. From a histological point of view this change in character is extremely interesting. The cells at the periphery of the cords show a palisade arrangement as in basal-cell carcinoma (fig. 62). The centre of the tumour cords shows necrosis or shows an opening, and very often the layer of cells bordering this central lumen shows palisade arrangement in the same way as the cells at the periphery (fig. 63). As



Fig. 61.—Section of stomach tumour (low power).

a result of this process, certain parts of the tumour simulate adenocarcinoma. This resembles very much what is found in many tumours in the human

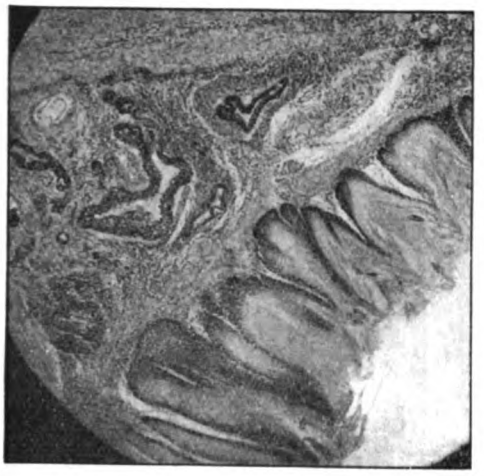


FIG. 62.—Growth of tumour beneath slightly hypertrophied epithelium of stomach.



FIG. 63.—Palisade arrangement of cells lining central lumen of tumour cords.

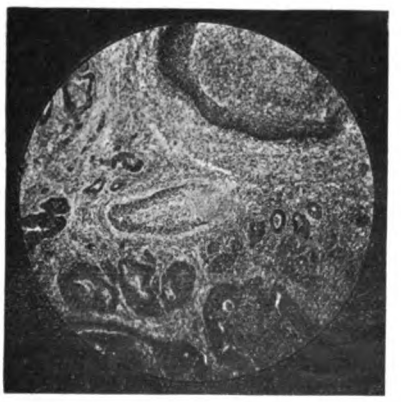


FIG. 64.—Blood-vessel showing partial thrombosis and filled with tumour cells (serial section 178.)

body, sometimes of uncertain origin. In tumours around the nasal cavity, e.g., a similar histological picture is often seen. The rat tumour shows quite clearly that this type of neoplasm may arise from the ordinary stratified pavimentous epithelium. The invading atypical growth classifies the tumour as an epithelioma, a cancer, and any hesitation about it is removed by the fact that an indubitable invasion of blood-vessels is visible in a large series of sections (figs. 64, 65).



FIG. 65.—Same vessel as fig. 64. Elastine staining (serial section 183).

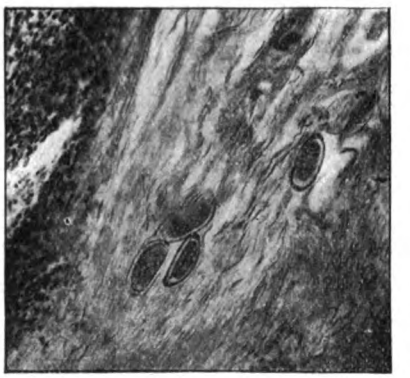


FIG. 66.—Eggs of *Hepaticola gastrica* in epithelium.

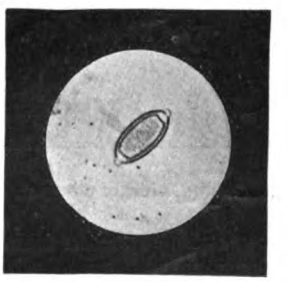


FIG. 67.—Egg of *Hepaticola gastrica* from rat's stomach.

Is the presence of the tumour and of the *Hepaticola* merely a coincidence, or is there a causal connection between the two?

Through Fibiger's work we knew already that spontaneous tumours of the stomach of the rat of a certain size were extremely rare. He found no true new growth in 1,144 rats examined. Wassink examined the stomachs of 625 rats from various

sources in Amsterdam and 625 other rats from ships, and never found a definite spontaneous tumour in the stomach. Fibiger, as well as Wassink, found stomachs, infected with *Hepaticola*, many times, but never with definite tumour formation. Wassink has kindly shown me his slides of *Hepaticola*-infected rat stomachs, which did show some epithelial reaction. In his most pronounced case there was



FIG. 68.—Eggs of *Hepaticola gastrica* in epithelium (cross section).

a formation of relatively large epithelial cysts filled with horny masses. For these reasons Fibiger and Wassink concluded that *Hepaticola*, or *Trichosoma*, as it was called by them, could not cause tumour formation; it seemed as if *Gongylonema neoplasticum* was the only worm capable of producing cancer in the stomach of the rat.

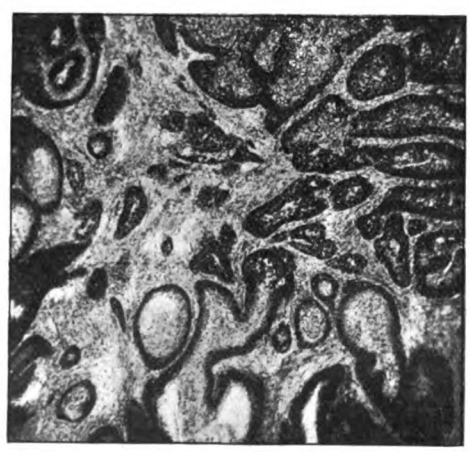


FIG. 69.—General view of stomach tumour.

Beatti, however,[1] has reported from Buenos Aires the finding of three rats infected with a nematode which he identified as probably *Hepaticola hepatica*, and presenting a tumour of the cardiac portion of the stomach. Two of these tumours are described as papilloma, sarcoma and epithelioma, all present at the same time in one stomach; the third tumour is described as an epithelioma. This last case and one of the other cases had metastases in lymph glands and liver. In the rat from Villa Lagarina, described here, there was no trace of sarcoma. From the description of the worms and their eggs, there seems to be little doubt at present that Beatti had really *Hepaticola gastrica* before him. In all four cases, the presence of *Gongylonema*, together with *Hepaticola*, in the same rat must be excluded, especially in South America, where *Gongylonema neoplasticum* is known to occur.



FIG. 70.—Cross section of *Hepaticola gastrica* in stomach tumour.

Fibiger received it from the West Indies, Wassink received it from Surinam, and recently I received them myself again from Surinam. But, of course, from the West Indies to the Argentine is a long distance and I do not know of any report of *Gongylonema neoplasticum* from the Argentine. Also from Italy *Gongylonema neoplasticum*, as far as I know, has never been reported, and I have not been able to find it in the Villa Lagarina rat, which

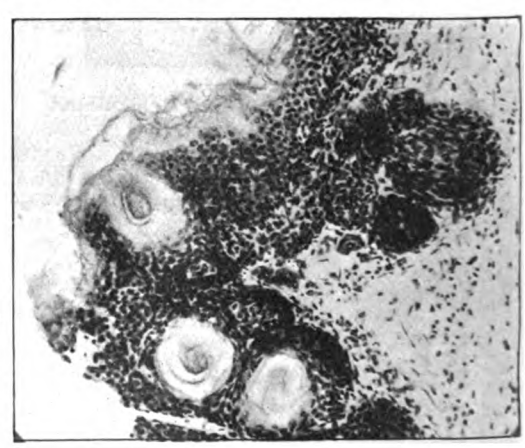


FIG. 71.—Buds of epithelial proliferation near the tumour.

was especially examined for the purpose. Many other rats from Villa Lagarina were infested with *Hepaticola*, but none with *Gongylonema*. With regard to this rat, therefore, *Gongylonema* seems to be definitely out of the question.

In and on the epithelium of the stomach around the tumour and on the tumour itself, a large number of worm eggs are visible in the sections. These

[1] *Zeitschrift für Krebsforschung*, pp. 207, 325. 1922.

eggs have an oval shape and at both ends they have a kind of plug in the thick eggshell (figs. 66, 67). Within the eggshell there is no larva visible, usually it contains one cell with a nucleus, that shows no signs of division (fig. 68). These are characters of *Hepaticola*.

In a series of sections near one side of the tumour, cross-sections of a worm or worms are present (fig. 70). Following up this worm in the serial sections, I can see that one worm is lying in an epithelial gallery, partly in the more or less normal epithelium of the stomach wall, partly in a gallery, very deep between the finger-shaped papillomatous excrescences of the tumour. The diameter of this worm, where it lies in the tumour, is about 50-58 microns. I cannot with certainty make out whether it is a young male or female.

In the epithelium of the stomach wall, near the base of the tumour, there are patches of epithelial proliferation. Small bud-like down growths of the epithelium are present at these spots. The muscularis mucosæ bulges out into the submucosa underneath these epithelial buds, but at other spots they invade the muscularis mucosæ and sometimes go right through it (fig. 71). The character of the epithelium, however, remains rather typical, and although one could not tell what would have happened, if the irritation at such spots had continued, it is obvious that, histologically, one is not entitled to speak of invasive tumour-growth at these spots. It is interesting to note, however, that we find here the same patches of heterotopical epithelial proliferation, that have also been described by Fibiger in *Gongylonema*-infected stomachs.

Discussion.

In comparing the histological changes present in the stomach of this rat with the changes in the stomach of Fibiger's rats, infected with *Gongylonema neoplasticum*, we are struck by a large number of similarities. The position of the worm in epithelial galleries is very much the same. The heterotopic invasive reaction of the epithelium is also described by Fibiger as very common in his rats. The presence of the papilloma with a secondary formation of an epithelioma resembles the formation of Fibiger's tumours in his *Gongylonema* experiments. The peculiar character of the tumour-cords in this *Hepaticola*-infected rat is not especially mentioned in Fibiger's work. In his descriptions as well as in the accompanying photographs, the tumours seem to be pure squamous-celled carcinomata.

Now that four cases of gastric cancer of the rat combined with the presence of *Hepaticola* have become known, it seems that *Gongylonema neoplasticum* should not be considered the only worm, capable of producing this pathological condition. Feeding experiments with *Hepaticola* are necessary to prove the rôle of *Hepaticola* experimentally. It is possible that *Gongylonema* may be a better agent in producing cancer than *Hepaticola*. Fibiger must have seen a very large number of *Hepaticola* rats without tumours. Wassink reports about ninety-nine rats from Amsterdam that were infected with *Hepaticola* in the stomach and did not notice anything worthy to be called a tumour. Still, on sixteen Surinam rats spontaneously infested with *Gongylonema*, Wassink found two well-developed papillomata, and recently I found myself one carcinoma, one large and five small papillomata amongst seventy-seven *Gongylonema*-infected rats from Surinam. But, besides the difference between the worms, other influences may be at work, causing differences in tumour-frequency in naturally-infected rats.

Summary.

In Villa Lagarina, a village near Trento, in Northern Italy, a wild rat (*Rattus norvegicus*) was found with a cancer of the cardiac portion of the stomach. The stomach harboured a nematode worm, *Hepaticola gastrica*. This is the fourth case described of the combined presence in the cardiac portion of a rat's stomach of a cancer and *Hepaticola*. It seems as if *Gongylonema neoplasticum* is not the only worm capable of producing cancer in the stomach of rats. In the same Villa Lagarina rat a mammary fibro-adenoma was present.

NOTES ON MYCOLOGY.

By J. Ramsbottom.

At the request of Dr. Sambon I joined his party for a period of a fortnight—afterwards extended to three weeks—with the object of investigating any mycological matter which might arise and of training Dr. Pan in collecting methods. Dr. Pan had worked with me for several weeks before we went to Italy, and had arranged to stay until the Commission left; I am indebted to him for his assistance while I was with the Commission.

As is stated elsewhere, the problem of the food of house beetles or of the possible presence of intestinal symbiotic fungi did not arise.

While investigations were being carried on at Villa Lagarina as thorough a search as possible was made in the houses where cases of cancer had been reported, and throughout my stay every opportunity was taken of examining the woodwork of houses. It is common knowledge that many fungi are quite frequent in houses, but the conditions met with in the Trentino were not such as would generally favour their presence.

Microfungi, e.g., *Stilbum erythrocephalum*, occurred commonly on rabbit pellets wherever these animals were kept, and the usual coprophilous Discomycetes and Pyrenomycetes appeared when the dung was kept moist for a day or two. *Chætomium* was frequent on bedding-straw and sterile white mycelia were present under practically all the boards which were lifted up in the stables; those examined invariably showed clamp connections, indicating that they belonged to Basidiomycetes. Such fungi were the only ones found above ground in the houses with the exception of a couple of rafters,

one at Villa Lagarina and one at an inn at Pelazzano, which showed the conidial stage of the common sulphur bracket fungus, *Polyporus sulphureus:* in these examples it is more or less certain that the fungus mycelium was already in the wood when it was first used. Otherwise no trace of fungal hyphæ was found on any such wood examined, i.e., rafters, flooring, doors, &c., except that occasionally coniferous wood showed the "blueing" characteristic of attack by *Ceratostomella.*

In a couple of houses at Villa Lagarina opportunity arose of visiting wine cellars. Both of these happened to be cancer houses, but it is not suggested that this is of significance. In the first house the cellar was cool, dark, and a little damp, though there was no standing water nor trickles down the walls. Wine barrels stood on heavy pine props which were said to have been piles of a bridge. Practically all over this wood an abundant fluffy white mycelium luxuriated, and collapsed when touched. This was obviously the aerial mycelium of *Merulius lacrymans,* the dry rot fungus. With the aid of the dull light from the single electric bulb—an amusing luxury when one considers the other domestic conveniences—supplemented by matches, it was possible to find the various stages of this fungus. As *Merulius* has often been regarded as a cause of human illness, it may be well to say a word or two about its habits. There are at least four varieties of the fungus, to which Falck has given the names *Merulius domesticus, M. silvester, M. minor,* and *M. sclerotiorum. M. domesticus* is the common species met with in houses. As the highest temperature at which it will grow is 80° F., this should acquit it from suspicion of causing human ailment in any direct way. This does not mean, however, that a house riddled with dry rot is desirable as a residence. The fungus is the most destructive fungus of worked wood known. It is mentioned in Leviticus as "Plague of leprosy in a house"—and in the days of the wooden walls of old England was the cause of much destruction in ships, as Pepys relates in his account of a commission of inquiry in the reign of Charles II. The fungus requires for its development a fairly warm, moist atmosphere, with little or no ventilation. The spores, though thin-walled, are long lived, and it is probable that a percentage of them are able to retain their vitality for several years. However this may be, they are rarely absent from houses where appropriate conditions for growth occur. On germination the spores put out a mycelium, which, having gained entrance into the wood, assumes two modes of growth. One type of mycelium ramifies within the wood and, living on the substance of the cell walls by the aid of enzymes, reduces it to a brown powder. The other type is superficial and spreads over the surface either as a thin whitish fish-skin-like film, or, when conditions are most favourable, as snow-like masses. As a result of the destruction of wood water is formed, and this is exuded by the fungus. The presence of these water drops explains the specific name of the fungus, but puzzles the lay mind in attempting to distinguish between dry rot and wet rot. These popular names are usually employed to signify whether the rot is in worked wood or unworked wood, i.e., whether the rot starts after seasoning, when the wood is dry, or whether it is present in the standing tree.

When growing in a confined space the film sometimes shows a yellowish tinge. The external mycelium apparently serves as a means of expansion over wood. In the cellar in which the fungus was first seen another type of vegetative spread was shown with textbook-like clarity. As the fluffy mycelium reached the walls and the ground it took on the film-like growth which passed into mycelial cords. These are at first white threads or strands with a somewhat floccose surface, and become grey or even blackish. It is by means of these cords that the fungus is able to spread from one source of food supply to another, passing through the mortar of brickwork, under tiles, and so on. Only the beginning of a couple of fructifications was seen. These show a honeycomb surface which becomes cinnamon in colour as the spores ripen and may be so much as a yard across. Millions of millions of spores are formed even by a sporophore of much more usual dimensions. Fructifications may appear on woodwork or even on walls. It is usually a sign that considerable damage has already been done when fruit bodies appear on woodwork; when they occur on material which provides them with no nutriment they are seen to be attached to the mycelial cords which conduct food from the seat of destruction. In the same cellar four other fungi were found: *Poria vaporaria* and *Fomes annosus* on the props and *Coniophora puteana* and *Trichothecium roseum* on the barrels. *Poria vaporaria* and *Coniophora puteana* are well-known dry rot fungi and are frequently found associated with *Merulius. P. vaporaria* forms a continuous persistent stratum and has a surface of large angular toothed pores which are at first white in colour and then cream. It possesses mycelial cords which remain persistently white. *C. puteana* forms a somewhat membranous flat expansion, the upper spore-bearing surface being smooth and at maturity a brownish olive colour with a white mucedinous border. It also possesses mycelial cords, but these are brownish and then blackish. The mycelial cords of the three species show differences in microscopical structure and are the most ready means by which non-fruiting stages of these fungi can be distinguished. *Coniophora* requires considerable moisture for its development, and it has been suggested that it is always the forerunner of *Merulius. Fomes annosus* is the *Trametes racidiperda* of foresters. It is of the polypore type, and is a most destructive parasite of conifer trees, attacking them at the roots and causing a "heart rot." It is a common fungus in mines, leading to great loss in pit props. It is able to develop fully in darkness, and does not form the bizarre sterile forms which some few fungi as *Lentinus* spp. and *Polyporus lucidus* affect in such situations.

The fourth species, *Trichothecium roseum,* is a harmless saprophyte, being the mould which shows

as pink masses in decaying organic material, as for example on badly dried herbarium specimens. The proprietor of the house stated that the props lasted only five or six years, after which time they could not support the barrels.

The second cellar was that of a wine grower. This was deeper than the first one, and unlike it was reeking with water. Here the logs on which the barrels were supported again showed the snow-like mycelial masses of *Merulius lacrymans*. We were told that the fungus had to be scraped away every week or that it would fill the place; the logs were said to last several years. Covering the walls there was a layer about a quarter of an inch deep of the black sooty growth of *Rhacodium cellare*, a harmless but unpleasant-looking saprophyte characteristic of such situations. At one place near the steps were found a few fruiting stages of *Merulius tremellosus*, a species common on pine branches. It was not possible, under the circumstances of the visit, to make out how the sporophores were connected with any wood.

In the surrounding country the vineyards were blue with Bordeaux mixture, which was liberally sprayed on the vines from knapsack sprayers. It was interesting to see the trouble that was taken to apply this fungicide, and to find out that invariably the cultivator knew the generic name of the fungus he was fighting against and could procure odd specimens for demonstration. All spraying at the time of our visit was against the downy mildew, *Plasmopara viticola;* dusting with sulphur against *Oidium* (*Uncinula necator*) was occasionally to be seen. Another disease which caught the eye was *Ustilago Maydis*, appearing on various parts of the maize plant, but particularly in the inflorescences as large greyish balls of which the thin outer membrane breaks to disclose a mass of dark brown powdery spores.

The smut of oats (*Ustilago Avenæ*) was common; also brown rust (*Puccinia triticina*) and black rust (*P. graminis*) of wheat. The alternate stage of this last species was exceedingly common on barberry in the Dolomites.

Several of the horticultural plants in the gardens at Villa Lagarina were covered with the oidium stage of mildews—roses, chrysanthemums, peas, &c.

The villagers are very fond of toadstools as food in the autumn, and dried fungi were to be seen in some of the shops at Rovereto. These appeared to be *Boletus edulis*. The common mushroom is apparently not a favourite with the villagers, judging from the remarks made when a coloured plate of this fungus was shown to them. The Italian curse that one may die of eating a *Pratiolo* suggested that this might be so. Apparently all the usual silvicolous fungi are eaten. In a restaurant at Milan the well-known esculents, *Amanita Cæsarea* and *Boletus reticulatus* were displayed, and later on in Trento, species of *Boletus*, *Cantharellus cibarius* and others appeared in the shops. The Trentino is classical ground for the larger fungi owing to the researches of the veteran mycologist, Abbé G. Bresadola, of Trento, whose acquaintance several members of the Commision had the great pleasure of making at his summer retreat at Varena, where he was actively continuing his researches.

While at Villa Lagarina a search was made through the gardens and vineyards adjoining the houses for the presence of crown gall. The result was disappointing. There was a single suggestive open canker on a rose bush, but although a large area of vineyard was traversed, no crown gall was seen. However, one learned that the disease was known to some of the growers, and an intelligent youth offered to find specimens for us; he produced a few small examples by digging somewhat recklessly at the roots of vines and an almond tree.

Observation was kept on the " geranium " plants (*Pelargonium*), which seem to be as great favourites with the villagers as is *Aspidistra* in this country. The only galls seen, however, were on experimental plants shown to us at the Serological Institute at Milan. Later we were shown good specimens on various trees at the Bacological Institute at Trento, and discovered others in the museum at the Agricultural College at San Michele. There can be no doubt that the disease is common in Northern Italy, but it was not possible to make search underground for it; its prevalence or otherwise on vines would best be ascertained at the time they are lifted, when a small monetary recompense would doubtless ensure specimens from a by no means unintelligent community.

The interest in crown gall has been considerable during the past few years, principally owing to the labours of Dr. Erwin F. Smith, the eminent American phytopathologist. He has published a series of papers during the last twenty years or so in which comparisons have been made between the appearances in crown gall of plants and human cancer. The following account is summarized chiefly from his writings.

Crown gall occurs as swellings or tumours on many cultivated plants and on some wild ones, usually at the collar or crown of the plant, though often at the roots or on the stems, and has been recorded from all over the world. The appearance of the gall differs according to the host plant, and may be hard or soft and of any size up to more than a yard in diameter. The cells of the host which are attacked are not killed, but are stimulated to multiply, the result being an imperfectly vascularized overgrowth composed in part at least of masses of rapidly dividing cells of reduced size. Attacked branches frequently are killed, but the whole plant seldom succumbs. The disease is of a peculiar type: (1) the growth is extra-physiological and injurious to the rest of the plant, slowly dwarfing or killing it; (2) secondary tumours occur as growths from tumour strands which are deeply embedded in the normal tissues, and derived by cell division in the form of a continuous chain of cells from the primary tumour; (3) the secondary tumours reproduce the structure of the tissues in which the primary tumour has developed even when they occur in other organs,

e.g., if the primary growth is in the stem and the secondary is in a leaf, the attacked part of the leaf will be converted into a pseudo-stem.

The growth of a tumour may stimulate multiplication of the surrounding uninoculated tissues.

The causal organism was first isolated and cross inoculations made by F. Cavara, Professor of Botany in the Royal University of Naples. It was named *Bacterium tumefaciens* by E. F. Smith and Townsend. It is a small, white, motile, rod-shaped organism with polar flagella, non-sporiferous, Gram-negative, non-acid fast, and grows on agar poured plates in the form of small, circular, somewhat raised, wet-shining, translucent colonies. It grows at from 0° to ± 37° C., the optimum temperature for growth being 25° to 30°. There appear to be at least three strains of the organism isolated from plants.

The bacterium has never been clearly demonstrated inside the tumour cells. According to Smith it "occurs only inside of certain of the proliferating cells. When the cell divides, the organism is carried over into the daughter cells, in at least a part of which it multiplies. It occurs in the cell in comparatively small numbers and, owing to the granular nature of the protoplasm, cannot be made out satisfactorily even with high powers of the microscope." The suggestion that human cancer might be due to some parasite endowed with similar chemical activities to *B. tumefaciens* has not been favourably received by the majority of botanists owing to the differences in structure between animals and plants; the absence of a circulatory system, in addition to a lack of a nervous and a central digestive system in plants apparently forbade legitimate comparison. The work of Professor Blumenthal, of the University Cancer Research Laboratory of Berlin, has, however, placed the matter in quite a different light. He claims to have isolated several times from human breast carcinomas a parasite in pure culture which is indistinguishable from *B. tumefaciens* obtained from plant tumours. Inoculated (either alone or with diatomaceous earth) into rats, mice, guinea-pigs, and rabbits, it produces malignant transplantable tumours which show in their histological structure the typical characters of sarcoma or carcinoma, growing to half the size of the animal and forming metastases almost as large as a walnut. In hot-houses and out of doors the parasite has repeatedly produced tumours on plants (especially sunflowers) indistinguishable from crown gall. The isolation from cancer is not easy, and only a small portion of inoculated animals have given persistent metastatizing tumours. Rat tumours are now in the eleventh and twelfth generation of transplant, the results being positive to the extent of 75 per cent. after the fourth transplant. Bacteria have not as yet been recovered from the transplants.

Such unexpected results have naturally aroused considerable scepticism. It should be stated, however, that Dr. Erwin F. Smith spent a fortnight in the Berlin laboratories and was convinced of the soundness of the investigations. "It begins to look, contrary to my belief hitherto, as if *B. tumefaciens* might occur frequently on or in man and be the cause of some of his cancer."

Assuming the correctness of this work, it remains to be seen whether the bacterium of itself is able to produce malignant growth in animals or whether it is the carrier of some ultramicroscopic virus; further, whether it is a special strain of *B. tumefaciens*, the cause of a world-wide disease of plants.

From the fact that *B. tumefaciens* has not been demonstrated with certainty in cells of plant tumours, it would be attractive to assume that it had an ultramicroscopic stage. Blumenthal (Auler and Meyer), discussing the reasons for the previous non-discovery of the human parasite, remark: "Gerade unsere Arbeiten mit dem *B. tumefaciens* bei Pflanzentumoren haben uns dazu geführt, beim Menschen am Rande des Tumors und in den erweichten Partien nach den Parasiten zu suchen." Recent work by Robinson and Walkden has shown that in certain cases at least of crown gall in plants, the bacteria which are located in the wounded surface and to some extent also in the vessels and adjoining intercellular spaces of the cortex are later present as a film on the rough outer surface of the gall. These results show the close similarity between crown gall and human cancer. There is growing conviction of the parasitic nature of cancer, but the whole gamut of pleomorphism, symbiosis and biological strains will doubtless be traversed in attempting to co-ordinate the results of recent researches.

ENTOMOLOGICAL NOTES WITH THE CANCER FIELD COMMISSION IN THE TRENTINO, 1925.

By K. G. Blair, B.Sc., F.E.S.

On the expedition to the Trentino district of Italy conducted by Dr. L. W. Sambon in July and August, 1925, the attention of the entomologists attached to the party was engaged mainly upon those insects that are known to be capable, or suspected of being capable, of acting as host in the early stages of the life-history of the Nematode worm, Gongylonema.

The insects thus observed fall into two categories, viz.: possible intermediate hosts of a Gongylonema that may attain maturity in man, and possible hosts of Gongylonema infecting domestic animals, particularly cattle and sheep.

Bearing in mind that for man to become infected with Gongylonema it is apparently necessary that the worm in its encysted stage should be swallowed alive by him, it is obvious that any insect liable to come in contact with human food is open to suspicion. This food may of course be such as is prepared and eaten indoors, or may be either carried outside or be gathered and consumed in the open. First, as regards food prepared and eaten indoors, it was known that at least two species of cockroaches, *Blatta orientalis* and *Blattella germanica*, occurred very generally in kitchens in the district, and considerable numbers were

collected, particularly from certain houses in which cancer cases had occurred, and were examined in our improvised laboratories for encysted worms. No trace, however, of Gongylonema was discovered in these cockroaches, though other parasites in some numbers were found. As the earlier cases of Gongylonema cysts to be found in these insects occurred only under experimental conditions, an attempt was made to repeat these experiments, and cockroaches of both the species mentioned were kept in confinement and as opportunity arose were fed with fragments of Gongylonema obtained from sheep and cattle at the slaughter-houses. These experiments, the details of which will be found in Dr. Baylis's report, were only partially successful, cysts of Gongylonema being later found in some of the smaller species of cockroach, though no trace of the development of the parasite was found in the more robust *B. orientalis*. Other insects found almost in all houses in which search was made in the flour bins were the common Meal-worm Beetle (*Tenebrio molitor L.*), occasionally found in the adult state, but much more often as the larva, and still more abundantly the Meal-moth (*Ephestia kuhniella*), again usually as the larva living freely in the flour or maize-meal, or spun up in the corners of the chest, especially above the level of the meal. Pupæ and a few adults were also observed. Although a considerable number of these larvæ were dissected and examined for Gongylonema, no trace of the worm was found, though a fairly high percentage, probably (accurate observations were not made) from 30 to 50 per cent. of the larvæ were attacked by one of its best known parasites, viz., *Nemerites canescens* Grav., a fly belonging to the parasitic Hymenopterous family, Ichneumonidæ. With the *Ephestia* larvæ were also the predaceous larvæ of the beetle *Tenebroides mauritanicus*. Other insects found in the kitchens were the Silver Fish (*Lepisma saccharina*) and some houseflies, but these, on account of the improbability of their ability to act as host to Gongylonema, were not particularly collected.

Other insects found not actually in the dwelling rooms of the houses, but sometimes in the ground-floor room, and also in outhouses and sheds in close proximity to the house, where chickens, and especially rabbits, were very frequently kept, were the Tenebrionid beetles, *Blaps lethifera* and *Tenebrio obscurus*. In both cases the larvæ were found occurring commonly with the beetles, and both species were frequently found together. They occurred in rather dry, dusty accumulations composed of earth, dried leaves, old straw, and rabbits' dung, this last usually more or less mouldy. As Gongylonema has already been recorded from other species of both *Blaps* and *Tenebrio*, and as rabbits' dung, possibly containing eggs of Gongylonema, obviously formed an important item in the diet of these insects, considerable attention was paid to them, but no trace of Gongylonema was found in either adults or larvæ.

Other insects found with them but in lesser numbers were the carabid beetle, *Sphodrus leucophthalmus*, which is predaceous upon *Blaps*, and a few smaller carabids, such as *Harpalus pubescens* and *H. griseus*, both occurring in quantity in the vineyards and gardens close by, and probably brought in with green maize and other fodder from outside.

Attention was also paid to the insect fauna of some of the village fountains. These fountains provide water for all domestic purposes, as well as for watering horses and cattle, and are usually arranged with a series of three troughs. The supply is in the form of a constant stream from a pipe line brought from some distance up in the mountains. From this supply water for domestic use, cooking, &c., is supposed to be taken direct, though in practice it is frequently dipped from the first trough into which this supply stream falls, and from which horses and cattle drink. The water in this trough is clear and well aerated, the sides clothed with green algal and mossy growths which harbour a number of different insects, as well as large numbers of a small pond snail, *Limnæa* sp. Water beetles, *Agabus nitidus*, and their larvæ were fairly numerous, as well as larvæ of certain Mayflies (*Bætis* sp.) and of such flies as *Chironomus, Psychoda, Pericoma*, &c., while on the outer walls of the trough, attracted by the moisture, were, in addition to the adults of the above-mentioned flies, such other species as *Orthoceratium virens* and *Elliptera omissa*.

From this trough the overflow supplies the second trough, which mainly serves for the final rinsing of clothes. The water here is more turbid with soap, though still fairly clear, and a few insects were still to be found in it. From this in turn the overflow supplies the third and much the largest trough, the walls of which have wide inward sloping slabs on which the soaping and kneading of the clothes of the village is carried out and the water in which is normally thick and turbid with soap, so as to be inimical to insect life. These insects from the fountains were not particularly examined for parasites.

Turning our attention to Dung-beetles, in connection with Gongylonema in cattle, these were collected in large numbers, and belonging to a fair number of species. Grazing ground in the vicinity of the villages is scarce, and is found mainly in narrow strips along the banks of the irrigating channels of the vineyards, and in some cases between the rows of vines, and the cattle here are usually found singly, and each beast, if not on a short tether, is in constant charge usually of a small girl or an old woman. Here and there is more extensive grazing of very rough nature, usually on a steep hillside encumbered with huge boulders and not good enough to be terraced for vines. It was on such ground that most of our collecting was done, every fresh cowpat being swarming with beetles. Most abundant of all was *Onthophagus taurus*, then probably the smaller shining red-spotted *Caccobius schreberi* and the more elongate *Aphodius subterraneus*. In smaller numbers were *Gymnopleurus sturmi*, the largest of the dung-beetles obtained in this way, *Oniticellus fulvus*,

Onthophagus opacicollis and *O. furcatus*, *Aphodius fimetarius* and *A. hæmorrhoidalis*, while occasional individuals of *Onthophagus nuchicornis*, *O. lemur*, *O. ovatus*, and *Aphodius erraticus* were also found. The larger dung-beetles, ***Ateuchus sacer***, *Copris* and *Geotrupes*, were not found at all, in the case of the first named possibly because the district was too northerly and beyond its range, in the case of the other two probably because it was a little too early in the season, a single specimen of *Copris lunaris* being found after the writer had left the party, while a number of *Geotrupes* on the wing fell into the car in the evenings. Most of these were dissected and examined for Gongylonema, and the sole example brought back was *G. mutator*; it is likely, however, that other very similar species were amongst the victims of the search for Gongylonema. With these dung-beetles were found a few other species of coprophilous habit, notably *Sphæridium bipustulatum* in large numbers, with a few Histeridæ, e.g., *Paçhylister inæqualis* and *Hister 12-striatus*, these latter two probably preying upon the larvæ of *Musca vitripennis* (Diptera), which were very abundant in the dung. A single example of *Emus hirtus* was also captured.

That these beetles were not restricted in their choice of pabulum to the dung of cattle was proved by the fact that most of them were as readily found in suitably fresh masses of human excrement on the same ground.

In several cases the dung in the sheds where Gongylonema-infested cattle had been stalled was examined for eggs of the worm, but without result, though in no case was the dung from the slaughtered animal positively identified.

Sheep were seldom seen except for occasional small flocks being driven along the roads, and there was no opportunity for collecting the dung-beetles associated with these animals.

Of the dung-beetles thus collected a fair number, about 4 or 5 per cent., proved to contain encysted worms of Gongylonema, as well as cysts of other nematodes. The beetles infected belonged to several species, e.g., *Onthophagus taurus*, *O. opacicollis*, *Caccobius schreberi*, *Oniticellus fulvus*, and *Aphodius subterraneus*; in fact practically every species of which sufficient individuals were examined appeared to be capable of allowing the development of Gongylonema. So far so good, but there still remains the question, how does the Gongylonema return to the cattle? For, in order to become infected, the cattle must swallow the encysted worm from the insect. Most of these dung-beetles shun the light, and when turned out of their cowpat make all haste to bury themselves in it again, or if unable to reach it quickly burrow down into the earth. The chances, therefore, of a feeding cow accidentally swallowing one of them would appear to be somewhat remote. One of these species, however, *Aphodius subterraneus*, was on one or two occasions observed out in the open, once crawling

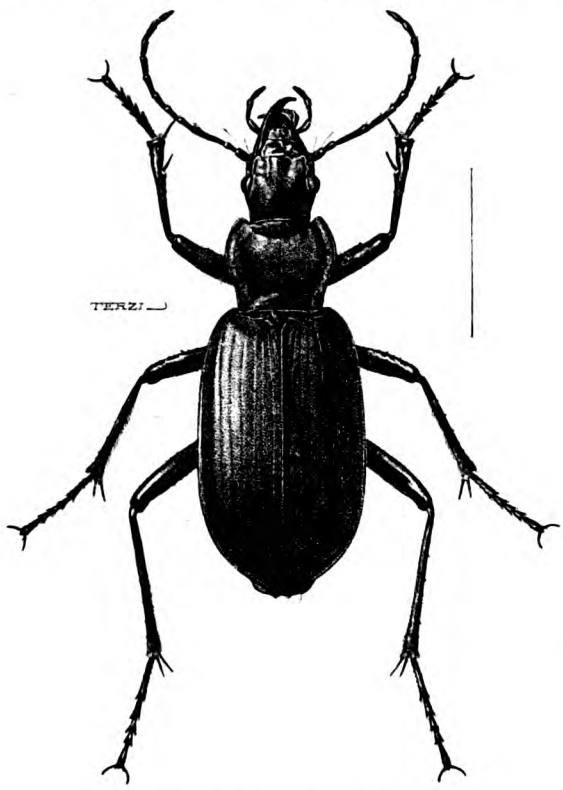


FIG. 1.—*Sphodrus leucophthalmus.*

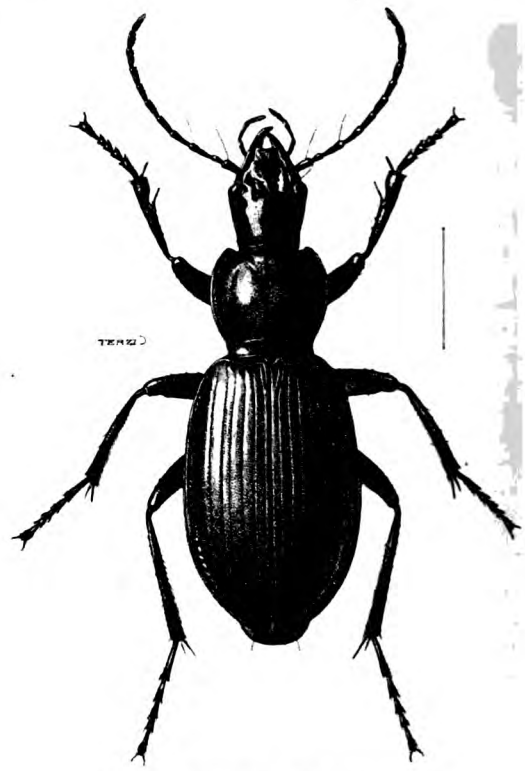


FIG. 2.—*Pristonychus terricola* ♀.

on the edge of a trough in the village, and once resting on a grass blade. Other species of *Aphodius*, particularly perhaps *A. contaminatus*, fly readily in the sunshine and are frequently observed crawling on herbage, so it would seem that some species of dung-beetles stand perhaps a greater chance of being swallowed by a grazing cow than others. Is this chance sufficiently great to acount for the high percentage of cattle from these areas found to be infested with the worm?

Another possible method of contracting infection is connected with the fact that if the encysted worm be placed in water it will rupture the cyst-wall and escape into the water. An infected dung-beetle may drop into a stream, or be flooded out of its cowpat after a storm and drowned, and on the decomposition of the body encysted worms would be liberated in the water and readily swallowed by man or beast drinking at the stream. It is by some such method of infection that the Gongylonema worms in the mouth of the girl swine-herd of Rome seen by Dr. Sambon were probably contracted.

Of insects other than those connected with the life history of Gongylonema a number of interesting species were observed. A large proportion of them were species common enough at home, though some very conspicuous species, e.g., amongst the butterflies, *Papilio podalirius* (and less commonly *P. machaon*), *V. antiopa*, &c., would cause some excitement if seen in this country. The male Gypsy Moth (*Ocneria dispar*) was not uncommon, dashing about over waste ground. This species was evidently kept well in check by parasites, the poplar trunks in the hotel garden providing numerous remains of young larvæ accompanied by single cocoons of a braconid parasite, though many of these cocoons produced only the hyperparasitic chalcid *Monodontomerus obscurus*. A bunch of eggs of the gypsy moth only produced *Anastatus bifasciatus*, which pretty little chalcid was bred also from a bunch of eggs of an unidentified pentatomid bug, while other groups of empty egg-shells of the same bug appeared to have produced the same parasite.

The telegraph poles on the road from Rovereto to Villa Lagarina were suffering badly from the attacks of a Longicorn larva, some of them appearing in imminent danger of falling, while the capture of two specimens of *Hylotrupes bajulus* sitting on the poles gave a clue to the culprit. Other interesting beetles of this group were *Ægosoma scabricorne*, a single specimen at rest on a lime trunk, *Spondylus buprestoides* flying in the hotel garden, *Criocephalus rusticus*, two specimens both ♀ taken at light, as also were two ♀ examples of the handsome melolonthid, *Polyphylla fullo*. The fine *Purpuricenus kaehleri* was found paired on a bush bordering a vineyard, while *Clytanthus varius*, *C. sartor*, *Leptura rubra*, *Strangalia attenuata*, *Grammoptera bifasciata* were swept from flowers in the gardens or vineyards.

A small sandy flat bordering the River Adige produced some poor grazing, and various insects in addition to dung-beetles; the runs of the Mole Cricket were much in evidence, while one or two of the insects were discovered, and other corpses were awash at the water's edge. A few *Cicindela hybrida* were captured with some difficulty, while the staphylinids *Pæderus gemellus* and *Stenus longipes* (?) were not uncommon. The little caddis-fly, *Oligocentrum maculatum*, was fluttering in numbers over the water, and the leaves of a small fig tree growing in the embankment near by were black with it. A number of large tabanids appeared to be not unwilling to transfer their attentions from the cattle to ourselves, but paid for their presumption with their lives.

On rough grassy ground *Mantis religiosa* was not uncommon, but mostly immature until August had well set in. The peculiar *Homorocoryphus nitidulus* was found in moister or more shady situations, but was also immature; a pink variety was found in addition to the usual bright green form. At night the small cricket, *Gryllus burdigalensis*, was very noisy by the roadsides, but it was not easy to track the noise down to the singer, nor to extract him from crevices in stone walls when found. Occasionally a specimen would be turned up by day under heaps of garden rubbish. Other long-horned grasshoppers taken included *Tylopsis lilifolia*, resembling our *Leptophyes punctatissima*, *Metrioptera albopunctata*, one female bearing numerous red acari between the wings, and *Decticus verrucivorus*, which, as its name implies, was at one time employed to bite away warts in the belief that this treatment would prevent their recurrence.

Odonata were but little in evidence except by the lakeside at Levico, where *Orthetrum cancellatum*, *Ischnura elegans*, *Platycnemis pennipes*, *Agrion lindenii*, &c., almost certainly *Anax parthenope*, were abundant. This fine æschnid with a conspicuous blue patch towards the base of the abdomen evaded capture. The handsome *Onychogomphus forcipatus* was taken by Lake Garda.

Of neuroptera the most striking were myrmeleonid larvæ, ant-lions, found in several places; from these *Myrmeleon formicaleo* emerged after our return home. The somewhat similar pits formed by the larvæ of the leptid fly, *Vermileo*, were found on ledges of walls at Villa Lagarina. *Ascalaphus* was not seen, unless a number of empty yellow eggshells arranged along a grass-stalk can be assigned to this genus.

Of Rhynchota some twenty species were collected of which probably *Pyrrhocoris aptera* was the most conspicuous, occurring in vast numbers and in all stages on walls, tree trunks, especially limes, and on the grass. Around Rovereto and Villa Lagarina the Cigale, *Cicada*, was very noisy, but with the exception of a few seen out of reach up in the trees we could not discover the songsters.

Besides the few Diptera already mentioned, captures included the fine *Stratiomys chameleon* and *Volucella zonaria*.

Stomoxys calcitrans was a considerable nuisance at Rovereto, but the pain caused by its stab soon passes away without leaving persistent irritation. Another interesting biter, both indoors and out, in the evening, was *Phlebotomus papatasii*. Mos-

quitoes were hardly seen, but were not worked. An *Anopheles maculipennis* was noted biting on the train as we left Venice.

On tree trunks here and there large, white, silky-looking patches were observed which, on investigation, proved to be a woody encrusting fungus covered with the shining web spun by the larva of a mycetophilid fly. From some of these larvæ the fly, *Sciophila ochracea*, was subsequently reared.

Hymenoptera, besides the parasitic species already mentioned, included such forms as *Ammophila*, *Cerceris*, *Scolia*, *Polistes gallicus* with nests, *Eumenes*, *Scelephron*, and others, mostly from flowers in the gardens. A nest of hornets was observed in a hollow lime tree, but was not investigated for scavenger or parasitic beetles. Ants, mostly *Lasius niger*, with some *L. umbratus* swarmed around the lights of the restaurants at night and were crawling all over the tables beneath them.

In all about 250-300 species of insects were noted, about 100 of which were Coleoptera. For a month's stay this is not a long list and includes little in the way of rarities, but it must be remembered that opportunities for general collecting were not very numerous owing to our work keeping us for the most part either in the villages or their immediate neighbourhood, or in the laboratory working at the material collected. From an entomological standpoint the best country was merely passed rapidly through in the car on some of our longer excursions, with no time to stop and sample the insect fauna of the vicinity.

EXAMINATION OF CANCEROUS AND OTHER TUMOURS IN ANIMALS COLLECTED BY DR. SAMBON DURING HIS RECENT RESEARCHES.

By Sir G. Lenthal Cheatle, K.C.B., C.V.O., F.R.C.S.

Surgeon and Lecturer in Surgery, King's College Hospital.

Acting as consulting pathologist to the Tropical Disease Prevention Association, I have carefully examined the pathological material submitted by Dr. Sambon, together with his Report on cancer field researches recently made in Italy and Holland. The results of my examinations fully agree with the statements he has advanced regarding the same.

Liver of Rat with Cyst of *Strobilocercus fasciolaris*.

A cyst in which is included a bladder-worm. In one corner of the cyst part of the larval cestode is embedded. At this point the tissue in which the strobilocercus is embedded is a large spindle-celled tumour the blood-vessels of which are in a very unorganized state. In one part of the section there is a piece of liver against which part of the tumour described impinges, pressing together the walls of blood-vessels. At this point there is no actual invasion of liver tissue. In other parts of the tumour there appear to be collections of cells which look like liver cells, as if the tumour had invaded the liver and destroyed part of it.

Kidney of Rat with Worm-Cyst.

A multi-locular cyst completely surrounded by renal tissue except one part, where a tumour consisting of epithelial cells is bulging into one of the loculi of the cyst. The epithelial cells of the tumour resemble renal epithelial cells. In no part is there invasion of normal renal tissue, but the tumour seems to be pressing it on one side. In the tumour itself the epithelial cells are collected in masses that vary in size from a collection of about forty or fifty cells to large collections of innumerable cells, and both the large and small clusters are separated from each other by fine strands of delicate connective tissue.

Stomach of Rat with Malignant Papillomatous Growth.

In this cancerous wild rat found by Dr. Sambon in Villa Lagarina, Italy, were two tumours: a benign breast fibrous tumour and a papillomatous tumour growing from the walls of the cardiac portion of the stomach. This papilloma is definitely malignant. The slides of this neoplasm prepared by Dr. Bonne, a member of our Field Commission, show that the epithelial cells have invaded a blood-vessel in which the elastica has been stained, and there is no doubt that it is a blood-vessel that has been invaded by carcinoma. In the connective tissue of this malignant papillomatous tumour can be seen a nematode worm (*Hepaticola gastrica*) in cross section and another similar worm at the base of the growth. Scattered over the walls of the stomach are the characteristic lemon-shaped eggs of this parasite. Hence I agree with everything Dr. Bonne has described in his contribution to the Report.

Rat's Breast Tumour.

Judging from the size of the sections and from the macroscopic size of the mammary tumour in the Villa Lagarina rat, the microscopical sections appear to be slices of the whole breast. There is no suggestion of epithelial proliferation, but the connective tissue surrounding the lobules, around the ducts and around the acini, has undergone very marked proliferation. In some parts the proliferation is more marked than in others, giving rise to the impression that there has been a generalized fibro-adenomatosis of the breast. No worms can be seen in these sections.

Original Communication.

CONCERNING THE DISCOVERY OF THE PLAGUE BACILLUS.

By E. LAGRANGE, M.D.Liège, D.T.M.Paris.

Former Assistant of Dr. Yersin in Nha-Trang (Indo-China).

THE wide publicity given to an article on "The History of Plague in Hong-Kong," by A. G. Millott Severn [1] led us to review a point which appears to be obscure. We have reviewed original papers, in order to clear up this misunderstanding.

The matter is not without interest, in view of the many contradictory opinions which have been advanced and which shall be discussed directly.

In June, 1894, Kitasato, then head of a Japanese Commission, and Yersin, a French doctor, came to Hong-Kong to study plague. Within an interval of a few days both claimed that they had discovered the ætiological agent.

These two young promising scientists had already a glorious scientific career behind them.

In 1894, when Yersin was 31 years old, he had already collaborated with Roux in 1887-1888 on the classical communication on diphtheria and its toxin. After several months' travel in the Far East, as a physician in the Merchant Marine in the South China Sea or as explorer in French Indo-China, being in Saigon he was sent to Hong-Kong by the French Government to investigate the new epidemic.

In 1887, Kitasato isolated and cultivated the bacillus of tetanus, and in 1890, with Behring, demonstrated the antitoxic properties of the antitetanic serum. When he returned home in the splendour of the Meiji, he soon found himself at the head of the bacteriological movement in Japan.

These were the two investigators who opened the fight against the terrible plague. Their communications have been published in various journals. Our purpose is to examine them carefully and to determine who was really the discoverer of the plague bacillus.

* * *

Although Europe was for a long time free from plague, the disease was endemic in South-Western China.

Aoyama [2] has shown that plague was diagnosed in 1884 in Pakhoi; that it was endemic also in Yunnan and Mongolia. At the time of the epidemic in Hong-Kong in 1894, Yersin nearly escaped being sent there for bacteriological studies. The first cases of plague appeared in May, 1894, in Hong-Kong amongst the Chinese community. The disease was already prevalent in Canton (about 100 miles away), and when Dr. Lawson, the British Health Officer, was sent there, he was soon called back to Hong-Kong to face a widespread scourge.

On June 12, Professor Kitasato and Aoyama arrived at Victoria, each of them with an assistant and a medical student, who joined the Commission.

On June 15, Dr. Yersin, a doctor in the Colonial Service, arrived alone.

* * *

The activities of the Japanese Commission have been related in a most interesting paper by Aoyama, who was in charge of the clinical and anatomical investigations.

He describes the general conditions of the city and the locations of the hospitals. After a fortnight, he and an assistant came down with plague, which they contracted at a post-mortem examination.

Three hospitals were set aside for plague patients at the beginning of the epidemic. A floating hospital was reserved for the Europeans; the second was a Chinese hospital under the care of Chinese doctors, and finally the Kennedy Town Hospital, a former police station, was under the care of English doctors.

Here the two scientists were allowed to perform post-mortem examinations. Later on, these hospitals became insufficient for the needs, and abandoned glass works, "un bâtiment affreusement délabré," a new slaughter-house under construction, and finally a straw hut, officially called Alice Memorial Hospital, were employed to receive the sick.

A very poor arrangement, according to Aoyama; no beds, no blankets, no mosquito-nets available; and mattresses only for Indians and Japanese. A photograph reproduced in Aoyama's paper shows the half-naked patients lying in a large warehouse, where numerous mosquitoes entered at night.

Even to-day the Chinese quarters of Victoria City strike the European tourist by their filthiness. From 165,000 to 250,000 people, according to different census, were huddled together under the worst conditions; filthy houses, foul-smelling streets, bad or no sewers; everything seemed arranged for the best conditions for the spread of plague.

Kitasato arrived on the 12th and started work on June 14 [3]; at an autopsy, performed by Aoyama, at the Kennedy Town Hospital, numerous bacilli were found in an inguinal bubo and in all the viscera. But owing to the fact that the autopsy was performed eleven hours after death, he doubted the specificity of the bacilli. He also cultivated and inoculated the bacterium into mice. On the same day he examined the blood taken from the finger of a case with an axillary bubo, who had a temperature of 40·5 (105° F.), and found an encapsulated bacillus, resembling the bacillus of chicken cholera.

Although he doubted the reality of his discovery, the local papers, the same day (June 14), published Professor Kitasato's discovery of the plague bacillus. The papers stated that the bacillus was a long rod, abundant in the blood of patients who had died of the disease.

The next day Yersin called upon Professor Kitasato and found him making an autopsy. He was surprised to note that Kitasato paid no attention

to the bubo, but simply examined the blood and the spleen. According to Yersin's diary, it was only later on that Kitasato was advised by Dr. Lawson to examine the buboes.

However, Kitasato cultivated and inoculated his bacillus, and noticed that all the laboratory animals, except pigeons, were killed within one or two days following the inoculations. At death he found the bacillus in all the organs.

On August 11 *The Lancet* published a short editorial "from the notes of Dr. Lawson of Hong-Kong." The paper is illustrated with four drawings; one is a specimen of human blood stained by Kitasato which shows several bacilli (?) to about fifty red cells; a preparation of Kitasato's culture which shows similar elongated diplococci; and a fourth on which was a preparation of the spleen made by Lawson. As far as one can decide from these drawings, the bacteria appear to be pneumococci. This diversity in morphological appearance did not escape Kitasato, and he says: "The organism—which is a bacterium resembling the bacilli found in the hæmorrhagic septicæmias, except that the ends are somewhat more rounded—when stained lightly appears more like an encapsulated diplococcus, but when more deeply stained, it has the appearance of an ovoid bacillus. . . . When, however, it is focussed more accurately, it is still possible to see the diplococcus form."

This was the first description of the Kitasato bacillus: a very short one indeed. On August 25 *The Lancet* published Kitasato's report on his first researches [3]. He claims that the bacillus is found in the blood, the buboes, the spleen and the viscera; that it is a rod with rounded ends with bipolar staining. "I am at present unable to say whether or not 'Gram's double-staining method' can be employed. The bacilli show very little movement." The optimum temperature for the growth varies from 36° to 39° C.; the culture in broth appears turbid; the writer states he did not observe either the growth on gelatin or the presence of spores; he also notes the results of animal inoculations. On this Kitasato's claim rests; it is the only basis of his claim to priority.[1] But the fact that he could not decide upon the reaction to the Gram stain and that he observed the motility of the bacterium, shows that he was in doubt between several bacilli which were present in his slides and cultures, and that he could not separate or distinguish them apart. It seems that Kitasato was in a hurry to publish his first results.

We have to see further what he says in regard to the manner in which the bacillus reacts to the Gram stain.[2]

Aoyama's paper [2], published the next year, tries to elucidate this point. In sections made from buboes, he finds in association with the "Kitasato bacillus" [*sic*] micrococci and streptococci. The "plague bacilli" and the micrococci decolorize by Gram's method. "Aus der Verschiedenheit der Gestalt und der Färbarkheit der Blutbacillen mittelst der Gram'schen Methode glaube ich, dass sie von den Lymphdrüsen nicht identisch sind. Wenn die Streptococcen sich von den Ketten ablösten und zu zweien aneinender fügen, so ensteht das ähnliche Bild des Blutbacillus. Da die Streptococcen meist in den Blutgefässen der Lymphdrüsen anzutreffen waren, so vermuthe ich das die Blutbacillen von Kitasato weiter nicht als im Blute circulierende Streptococcen aufzufassen sind."[3]

This is the statement of Aoyama, who was associated with Kitasato in Hong-Kong. It is seen, then, that one year later he does not consider Kitasato's bacillus as the bacillus of plague!

If such is the current opinion in the Japanese scientific circles, it is evident that the work of Kitasato had not been accepted.

Let us follow Kitasato's next publications—after this "preliminary notice" and his official report.

The next communication [5] was written in Japanese in 1897, and is not to be obtained here. But in 1898 another communication appeared in which the writer gives a detailed description of "his" bacillus.

"In 1894 a scientific commission for the investigation of plague, directed by Aoyama and Kitasato, was sent from Japan to Hong-Kong, where the writer (Kitasato) was able to isolate the bacillus which is the specific cause of the malady." He then adds that the bacillus is not decolorized by Gram's method. "They are endowed with motility which is not very active, but which should not be mistaken for molecular movement. In order to observe their motility it is best to study them in a medium at the temperature of 37° C." Kitasato found this organism 25 times in 28 cases in blood preparations after finger puncture.

The article ends as follows: "It has been quite generally assumed that the bacillus above described is identical with that of Yersin, but this assumption is incorrect. The two are quite distinct, as

[1] These two articles in *The Lancet* as well as the statements in the local press in Hong-Kong explain the mistake of Dr. James Cantlie, who was in Hong-Kong at the time. In 1898, during a discussion of a report of Arnott ("Pathology of Plague"), Cantlie states that Kitasato and Yersin have been wrongly grouped as the co-discoverers of the plague bacillus. He states that Kitasato discovered the bacillus a week before Yersin, and although he has a great esteem for Yersin's work, he thinks that he cannot be considered as the "original discoverer of the bacillus." That distinction belonged to Kitasato alone. *Brit. Med. Journ.*, 1898, ii, September 24, p. 862.

[2] As soon as he returned to Japan, Kitasato published his official report in the *Japanese Official Journal* of August 30 and September 1, 1894. Ogata [9] has shown that Kitasato did not publish the same facts in this and his next papers. While in his second paper of 1897 (see below) Kitasato notices the presence of glands in the inoculated animals, in this first report he only notices a bacillus whose inoculation does not produce glands and which kills the animal, only after two to five days. Kitasato hence contradicts himself.

[3] "As the bacilli present in the blood differ in size and staining properties by the Gram method, I think that they are not the same as those present in the glands. When the streptococci are broken from their chains and are liberated, they may produce the appearance of the blood bacilli. As the streptococci are mostly present in the blood-vessels of the lymphatic glands, I think Kitasato's blood bacilli need to be considered as streptococci circulating in the blood."

may be seen from the following summary of their differences." Kitasato then cites the differences already published by Ogata, and he concludes at the time when Yersin had already prepared his serum (1896): "Further bacteriological investigations of plague are desirable." The following year another opportunity presented itself; during another Japanese epidemic, Kitasato continued in his error [7]. To quote: "Beside the pest bacilli, like those of chicken cholera, *staining deeply by Gram's methods*, staphylococci and streptococci were seen." Still, other investigators had already demonstrated his mistake in regard to the Gram stain with striking clearness.

Zettnow [8], in 1895, was able to make the comparison between the cultures received from Metschnikoff (probably of Yersin's bacillus) and slides sent by Kitasato to Koch. He took photographs of them. In a heart-blood preparation the Kitasato bacilli look quite like pneumococci; while those from Metschnikoff's cultures show the typical bipolar staining.

M. Ogata [9], in 1897, was greatly opposed to Kitasato's views and added: "Ausserdem sollte mann auf Insekten wie Flöhe, die infolge der Abkühlung der verendeten Ratten diese Tieren verlassen und das Pestgift direkt auf den Menschen übertragen Können, achtgeben."[1]

This is the first time attention was drawn to the important part of fleas in the transmission of the disease.

Metschnikoff, in 1897, although well versed in the literature, wrote as follows [10]: "Yersin après des recherches laborieuses effectuées dans des conditions particulièrement difficiles, découvrit le microbe pesteux. Indépendamment de lui, Kitasato arrivait au même résultat."[2]

And amidst all these contradictory opinions, Kitasato issued no further contributions on the subject; and yet most of the textbooks have called the plague bacillus the bacillus of Kitasato-Yersin.

In 1923, in an article by Kitasato on the scientific and medical development in Japan, he attributed the discovery of the plague and dysentery (Shiga) bacilli to Japanese scientists.[3]

However, in 1925, as chairman of the Congress of the Far Eastern Medical Association, before 400 members, amongst whom were 250 foreign delegates, Kitasato is to be honoured for having publicly stated that Yersin alone was the discoverer of the plague bacillus.

* * *

Through the courtesy of Dr. Dujardin-Beaumetz, head of the plague laboratory of the Pasteur Institute of Paris, we have been able to see some valuable documents concerning Yersin's studies in 1894.

Besides the slide here photographed, the official report of Yersin to the Governor of Indo-China and his unpublished and private diary were seen.

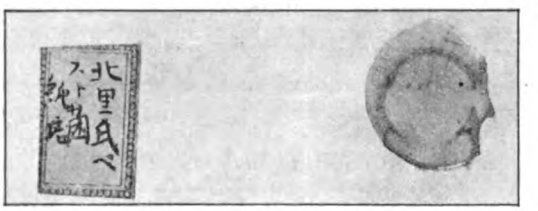


FIG. 1.—Slide presented by Kitasato to Yersin. The text reads as follows: Mr. Kitasato; plague bacillus, pure culture; staining by fuchsin; many germs are grouped by twos, and are difficult to recognize whether plague bacilli or pneumococci.

After many difficulties, Yersin finally arrived at Hong-Kong on June 15, 1894. He had an Annamese servant who had been with him in his exploration of Indo-China, and a Chinese servant who was engaged in Haïphong before he sailed.

His laboratory equipment was meagre: a sterilizer and some material to prepare media, but no incubator. He did not speak English. The French consul was alone and hence was unable to accompany him. Fortunately, he had an introduction to an Italian missionary, Father Vigano, a former soldier at Solferino, who helped him greatly.



FIG. 2.—Yersin's hut close to the Alice Memorial Hospital.

At the Kennedy Town Hospital, Yersin met Kitasato, who was performing an autopsy. The conversation was difficult as Yersin knew only a few words of German; they had no other common language.

During the first days at the hospital he could not obtain any autopsies; he was informed that they were reserved for the Japanese Mission. He had

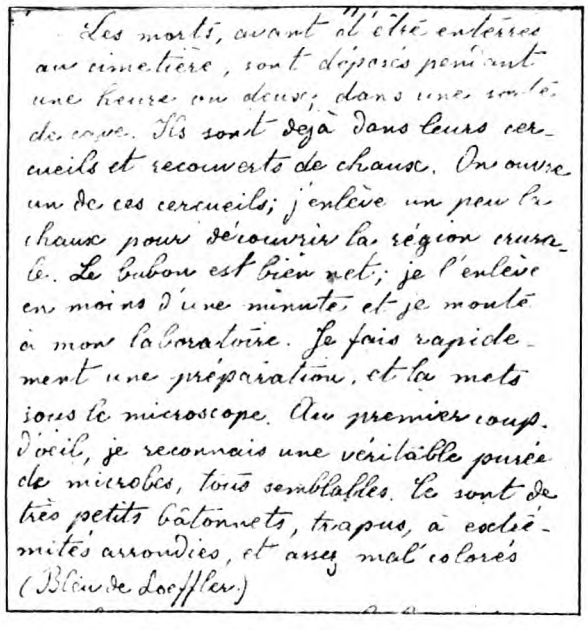
[1] "Besides, one should pay attention to insects like fleas, for as the rat becomes cold after death they leave their host and may transmit the pest virus direct to man."

[2] "Yersin discovered the plague bacillus after painstaking research made under very difficult circumstances. Independently, Kitasato obtained the same result."

[3] We regret that we cannot indicate the reference to this statement. In 1924, while sailing through the Pacific on a Japanese steamer of the Toyo-Kisen-Kaisha line, we had the opportunity to read a book describing the most important points of interest in Japan. It is a book (in quarto) with English text, abundantly illustrated, edited, 1924, by the Toyo-Kisen-Kaisha line. Despite a painstaking search we have been unable to find this book in Paris.

to content himself with the examination of blood from patients. He found no bacteria there. His laboratory was an open porch, with an easy access to any passer-by.

He finally decided to erect a straw hut near the Alice Memorial Hospital, where he worked and



Les morts, avant d'être enterrés au cimetière, sont déposés pendant une heure ou deux, dans une solution de chaux. Ils sont déjà dans leurs cercueils et recouverts de chaux. On ouvre un de ces cercueils; j'enlève un peu de chaux pour découvrir la région crurale. Le bubon est bien net; je l'enlève en moins d'une minute et je monte à mon laboratoire. Je fais rapidement une préparation, et la mets sous le microscope. Au premier coup d'œil, je reconnais une véritable purée de microbes, tous semblables. Ce sont de très petits bâtonnets, trapus, à extrémités arrondies, et assez mal colorés (Bleu de Loeffler).

FIG. 3.—From Yersin's diary.

lived. This was rather daring when we think that at that time both he and Kitasato believed that the plague was transmitted from man to man by mosquitoes and flies, as Yersin finally demonstrated to be the fact. Let us quote from his diary:—

"June 20. I have to-day paid several visits to obtain the permission to erect a straw hut near the hospital. I have again been refused the autopsies; as before, I was told that to morrow it would be my turn. In the meantime, I have satisfied myself that the plague bacillus is not chiefly in the patient's blood. I hope to be more successful by examining the bubo. But I cannot extirpate the buboes, as I cannot obtain autopsies, at least at the police stations. With the help of Father Vigano, I try to persuade some English sailors, whose duty it is to bury the dead from the city and the other hospitals, to let me take the buboes from the dead, before they are buried. A few dollars conveniently distributed and the promise of a good tip for every case have a striking effect. The bodies before they are carried to the cemetery are deposed for one or two hours in a cellar. They are already in their coffins in a bed of lime. The coffin is opened, I move the lime to clear the crural region. The bubo is exposed, within less than a minute I cut it away and run to my laboratory. A film is prepared and put under the microscope; at the first glance, I see a real mass of bacilli, all identical. They are very small rods, thick with rounded ends and lightly coloured (Löffler blue). From the bubo I inoculate agar tubes, mice and guinea-pigs. I take some secretion in a pipet to send it to Paris, and then return to the mortuary and try to obtain new cases. I obtain two other buboes with similar results. My bacillus is most probably that of plague, but I am not certain.

"June 21. . . . I go on cutting and examining buboes. I always find the same bacillus, extremely abundant. My animals inoculated yesterday are dead and show the typical plague bubo. . . . As I cannot obtain autopsies, I decide to address a claim to the Governor by way of the Consul.

"June 23. . . . In the future, I will obtain one autopsy of two. I may start one at once. I notice that there are no other constant lesions except the bubo in the cases of acute plague. The bacillus may be found diffused, but the chief location is always the bubo. . . . I try to collect as many cases as possible for the Pasteur Institute of Paris. I always take the secretion of the buboes in small glass tubes which I regularly send to France by mail. . . . I search and find the organism in the corpses of dead rats, and there are many throughout the city. . . ."

After a short stay at Canton, and as the epidemic was near its end, Yersin, considering his object fulfilled, left Hong-Kong on August 3 for Saigon. On July 30 E. Duclaux, director of the Pasteur Institute, read extracts of letters from Yersin before the Academy of Sciences [11] announcing in very definite terms the discovery of the bacillus of plague. The following September, Yersin's first paper was published in the "Annales de l'Institut Pasteur," with very clear photographs of the organism. The bacillus was very demonstratively described. The same paper was reprinted in October in the "Archives de Médecine navale et coloniale."

After a short stay in Paris, where, in collaboration with Calmette and Borrel, he succeeded in immunizing small laboratory animals [12], Yersin sailed again in 1895 for the Far East. He immunized horses against plague in Nha-Trang (Annam), while at the same time this was being done at the Pasteur Institute in Paris. Armed with sera, he went to Hong-Kong in June, 1896, and later to Canton, where he made his first trial with serotherapy on a young Chinese boy belonging to the Catholic Mission.

With 30 c.c. of serum he succeeded in curing his first case within less than 24 hours.

From there he went to Amoy, where of 23 treated cases he cured 21 [13, 14].

The Yersin bacillus of plague was hence demonstrated.

Yersin prepared his original serum by injecting living bacilli, but now this procedure has been abandoned owing to its danger. (Personal communication.)

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NOTES ON THE USE OF ESERINE IN GLAUCOMA.

By B. C. VACHHRAJANI, L.M. & S., B.M.S.,
Medical Officer Thar Parkar Civil Hospital, Mirpurkhas.

AS showing the value of eserine in the treatment of glaucoma, the following notes of cases, treated in the course of the work of the Blind Relief Association here, either in the civil hospital or by the touring medical officers of the Association, may be of interest.

Mianbai, wife of Piral (aged 45), of Phuladhi, in Taluka Khipro, seen in November in the village; glaucoma case. Had practically no vision, but treated in the camp with eserine, four grains to one ounce. Pupils contracted and vision improved at once, and after the third day's treatment she was able to see the tent. Unfortunately, as the camp was moving, she did not follow it up as instructed, and was not seen again.

Umar Bilawal Mangrio (aged 30), of Khami Mangrio, in Khipro Taluka. Glaucoma in left eye; right destroyed. On January 21, 1926, he had little more than perception of light. After one treatment vision greatly improved, but field remained very much contracted on the nasal side; did not follow up the camp, but was later brought to the civil hospital, where eserine treatment was continued, with the result that the field greatly improved. The man absconded before the treatment was completed.

Mulo Chanio Vagir (aged 40), of Chor, in Umarkote Taluka; glaucoma in both eyes; no sight in right eye, a little sight in left eye; field very much contracted on nasal side, and vision only at the extreme side of the field; was treated with eserine, four grains to one ounce,, for several days, and the field rapidly improved, till he had vision in the centre of the field and even further. As a test, the treatment was dropped for two days, and then he began to complain of a little headache and loss of field was noted. He was again put on eserine and the field again improved. Operation was suggested; he absconded and has not been seen since.

Sono Kesaro Bhil (aged 30), of Mithi Taluka; glaucoma in both eyes, with dilated pupils, especially in the right; had good sight in left eye; in right only perception of light. Treated with eserine (4 gr. to 1 oz.) on 14th, 15th, 16th and 17th February. Both pupils contracted at once. The perception of light in the right eye improved almost at once; on 16th he could see with that eye a white handkerchief and fingers within a few inches. On 17th he saw fingers at 10 ft. with that eye. Discontinued treatment, but later again turned up and eserine treatment was continued and ultimately trephining was done. No subsequent report yet to hand.

Two cases are reported from the Bijapur district of patients with glaucoma and no sight. Both recovered sight after constant eserine six times a day. One was seen again after a year and the sight was quite good. In one, and best of these cases, there was not even P. L. originally.

Generally here the instillation of eserine is given two or three times a day and the strength is 4 gr. to 1 oz.

The results indicate that eserine is a most valuable drug and should be given a good trial before operation. In one case at least where an operation was done first and eserine instilled afterwards, no improvement took place.

A NOTE ON FURTHER EXPERIENCES OF THE USE OF A PANAMA HAT IN TROPICAL AFRICA.

By J. F. CORSON.

IN a previous paper (1926) a few experiments to test the protective power of a Panama hat as a substitute for a helmet in tropical Africa, were recorded. The climatic conditions during the period of these experiments were comparatively mild and somewhat guarded conclusions were given. Opportunity has occurred since to make use of a Panama hat under much more severe conditions of exposure to the sun's rays. This form of hat has been worn exclusively during the last five months, viz., from November, 1925 to March, 1926, and during the latter half, from January to March, in the district of Musoma, on the eastern side of Lake Victoria. This district has an altitude of about 4,000 ft. above sea level and, in the parts traversed, is open hilly country with granite rocks and is sparsely wooded. There was little rain during the period, the sky being usually clear and the sun's rays strong enough to cause severe blistering of the exposed skin of the face, arms and legs. Circumstances involved travelling by dhow, canoes, bicycle and on foot during the hottest hours of the day until 3, 4 and 5 p.m. No unpleasant effects, that could be attributed to the action of the sun's rays on the head, were experienced either during exposure or afterwards. During long marches, the comfort of the light hat contrasted with the discomfort felt on many previous occasions when wearing a Wolseley helmet. It would not have been practicable, nor was it thought necessary, to make meteorological observations, the purpose being to test by practical experience. The protective power of pigmentation of the skin of the face, forearms and knees is well known to all European residents in the tropics accustomed to

travel, and it is possible that similar pigmentation occurs in the skin of the scalp under conditions of limited transmission of ultra-violet rays.

Conclusions.—A Panama hat has been found to be an efficient substitute for a helmet in tropical Africa under conditions involving exposures for several hours during the hottest part of the day. There is no reason to think that there are great individual differences in people in relation to this question but, until more general experience is available, nothing definite can be said as regards this. It may be suggested that additional comfort, by loss of heat, would be gained by making guarded ventilation apertures at the sides of the hat.

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Blood-Transfusion in Pernicious Anæmia (H. W. Jones, *Journal of the American Medical Association*, May 29, 1926).—Thirty patients were treated by transfusion; twenty are living; there were ten deaths. Of the twenty living, the time that has elapsed since transfusion varies from a few weeks to seven years. The time elapsing from the date of the first transfusion varies from two months to seven years. In five patients the blood has been brought to a normal count three times. In four patients the blood has been brought to a normal count twice. Thirteen of the twenty patients are performing at least a part of their duties. One patient in whom marked nervous phenomena developed was brought to a normal blood-count three times in a period of fourteen months. Death resulted from pyonephrosis. Hæmoglobin and red blood-cells were practically normal at that time. One patient died of pneumonia. The blood-count was normal. One patient with a blood-count nearly normal died of a hæmolytic reaction. One died because it was impossible to get further donors for him. His blood-count had been brought to normal twice. One patient refused more transfusion after being brought to a normal count twice. One patient, after being brought to a normal count twice, died six hours after transfusion given at the beginning of the third relapse. One died two days after the first transfusion. This is the only patient whom it was not possible to bring to a normal count at least once with transfusions when donors were available. In order to accomplish good results, the following points must be observed: a small amount of blood (100 c.c.) should be given at the first transfusion to offset the possibility of death in a very few cases, unless the patient requires a larger amount to carry him past the danger point. Whole blood should be used. Moderate amounts of blood, from 350 to 450 c.c., should be given. In the hæmolytic stage, the amounts should be increased daily, beginning with 50 c.c. The transfusion should be employed at four-day intervals.

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THE TREATMENT OF CANCER BY LEAD.

THERE can be no doubt that in the whole range of medical science there is no subject of greater interest or more pressing importance than the investigation and control of malignant disease provides. Blair Bell looks upon malignant neoplasia in the human subject as a biological atavism and considers that a considerable degree of parallelism exists between the cancer-cell and that of the chorionic epithelium. Further, a comparison between the chemical constitution of different tissues in regard to the factors concerned in growth-processes demonstrates clearly not only that malignant tumours are richer in this respect than the corresponding normal structures and innocent neoplasms of the same parts, but also that the physiologically malignant chorionic villi show

even higher values than pathologically cancerous tumours; the chorionic epithelium may thus be considered to be super-malignant. If, then, any substance could be found which would exert a selective destructive action on the cells of the chorionic epithelium, devoid of deleterious action on other tissues, it would seem reasonable to suppose that a similar selective destructive action would be exerted upon cancer cells and so bring about a cure of the neoplasm.

From quite ancient times the occurrence of sterility and abortion in animals and man in association with lead poisoning has been well known, and so widespread is this knowledge at the present time that in some districts, at any rate, lead is extensively employed by women as an abortifacient. The method by which this action of lead was brought about was thought to be by the production of hæmorrhages into the placenta as into the other organs of the body.

The experimental investigations of Blair Bell and his colleagues in Liverpool, however, have shown that lead causes specific abortion by its lethal action on the chorionic epithelium, with the production of a coagulation necrosis—a result which they were unable to obtain by the use of other metals, such as copper, thorium and thallium. On account of this selective activity for the chorionic epithelium abortion can be produced by the action of lead on the fœtal ectoderm (trophoblast) without the maternal organism being affected in any way, and it was found that the effective abortion dose of lead is approximately half the lethal dose.

Influenced by these analogies attempts have been made to treat cases of malignant disease by the administration of preparations of lead. For this purpose colloidal suspensions have been prepared and intravenously injected. Clinical work on these lines has now been in progress in Liverpool for about four years, and the type of case in which treatment has been conducted has been very varied, including carcinomata and sarcomata in all parts of the body. The cases were for the most part of a very desperate character, a large number having died within a few weeks of being seen for the first time. On the other hand, in some instances even hopeless cases, proved microscopically, have recovered under the treatment and are alive and apparently well to-day.

Some day it is hoped that a substance less toxic than lead to the organs of the patient, and even more effective than this metal in arresting and destroying cancerous tissue will be found, and then the hope that malignant neoplasia may be subject to control will have become an accomplished fact.

F. E. T.

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Annotations.

Depopulation of the New Hebrides and Other Parts of Melanesia (P. Buxton, *Transactions of the Royal Society of Tropical Medicine and Hygiene* February 18, 1926).—The people of the New Hebrides, and indeed, of Melanesia in general, are dying out. To some extent this is due to the constant wars, the belief in magic, the bad housing, the unsuitable feeding of infants, the treatment of women, the practice of abortion and other customs, all of which prevailed in the old days, and still prevail to a large extent in most parts of the group. But though one must bear the existence of all these facts in mind, one cannot regard them as directly responsible for the depopulation (which has set in during the last century), because the customs have prevailed from time immemorial. The majority of the Europeans who were in the group during the nineteenth century were trading either in sandalwood or in human beings. They are directly responsible for a great number of kidnappings and deaths, and they brought with them epidemics which sometimes carried off as much as a third of the population of an island in a few weeks. The credit for stopping this and rousing the public conscience in England and the British Dominions belongs, mostly, to the Presbyterian missionaries; but they are also in part responsible for the dying out of the people, because they rapidly destroyed the communal life and interests of the race, and put next to nothing in the place of what they destroyed; this was pointed out by Rivers several years ago, but what he wrote does not appear to have affected the policy of this mission. The fact that the government is a condominium makes administration very slow and uncertain, so that it is at present too difficult to suppress illegal recruiting and the sale of alcohol to natives. At the time of the author's visit, no free medical assistance for the native race was provided by the condominium. The system of recruiting is a compromise, perhaps necessary, between the interests of the natives and the planters. It is believed that it could be abolished if indentured labour were introduced. Among the endemic diseases, malaria and yaws are of major importance, because they render the race unhealthy and liable to succumb to introduced epidemics. They must only be regarded as two among many factors, all of which affect the question of depopulation; malaria is entirely absent from one island, but the population of that island has declined rapidly from other causes. Of the introduced diseases, dysentery and pulmonary disease are of very great importance. Apart from all these factors two very disquieting facts have been discovered. The rate of decline of the population of most islands is no less now than it was half a century ago; the race continues to die out, irrespective of the abolition of the "blackbirding" and of reduction in severity of epidemics. In all parts of the group about 118 males are born per 100 females, and this disproportion persists

through life. The continued decline and the excessive production of males almost warrant one in saying that the eventual extinction of many of the races now living in the New Hebrides is inevitable.

Malarial Fevers in the U.S. Army and at Selected Stations (A. G. Love, *The Military Surgeon*, July, 1926).—One hundred years ago malaria fevers were responsible for more than 25 per cent. of all admissions from disease to Army hospitals. Since the World War it has been responsible for only 1 per cent. In 1841, during the Seminole War in Florida, 50 per cent. of the admissions to post hospitals were charged to it, all admissions to the field hospitals being omitted from consideration. During the Mexican War it was apparently responsible for about 25 per cent. of the hospital admissions, and during the decade following for about 24 per cent. During the Civil War 23 per cent. of the admissions from disease were charged to malaria and it was only second in importance to the ever-present diarrhœa and dysentery. Among the white troops it caused 70 per cent. as many admissions as diarrhœa and dysentery, and among the coloured troops 100 per cent. as many. During the decade following the Civil War, 25 per cent. of the admissions from disease were due to this cause. This was the result in part of the stationing of the greater part of the Army in the south. This percentage was reduced to 10 per cent. during the decade preceding the Spanish-American War. During the Spanish-American War and the Philippine Insurrection, among the white troops in the U.S. malaria was responsible for 23 per cent. of admissions from disease; and during the World War for only one half of 1 per cent. The Army experience during both the Civil and World Wars indicates that fewer cases of malaria occur among the coloured troops than among the whites, but the fatality rate for the coloured is higher. In addition to the deaths and loss of time from the cases admitted to hospitals on account of these fevers, there was formerly much chronic invalidism and loss of military efficiency as a result of physical unfitness, which cannot be measured by vital statistics.

In certain sections of the country, a great deal was accomplished by what might be termed natural causes in the reduction of the prevalence of these fevers prior to 1900, when the mosquito was first definitely incriminated as being entirely responsible for the dissemination of these fevers. But the general reduction did not occur until after the introduction and continued application of intelligent anti-mosquito measures, with the protection of the mosquito from the infected individual and of the individual from the infected mosquito. Some of the measures used since 1900 are: drainage, oiling of all standing water; screening of all barracks, quarters, and especially of hospitals; thorough treatment of all malarial patients during both the acute and chronic stages; use of mosquito nets for the troops in the field and in barracks when screens are defective. Civic improvement and the bringing of waste and marshy areas under cultivation.

Military Service in the Tropics, and its Effect on Health and Efficiency (J. F. Siler, *The Military Surgeon*, July, 1926).—The present day Army regulations of the United States prescribe the following lengths of tour in tropical possessions: Philippine Islands 2 years, with extension if physically fit and applied for by the individual; Panama 3 years, and Hawaii 3 years, on the same conditions. A study of the records for the past 20 years shows that there have been marked reductions in the sick rates for white troops in the Philippine Islands from epidemic diseases, but the progress made in the control of the same group of diseases in the United States has been even more satisfactory. Comparatively speaking, therefore, health conditions have not changed in so far as general admission rates for epidemic diseases are concerned. The rates for venereal diseases are being reduced, but not nearly so satisfactorily as is the case in the United States; the rates for malaria are now at so low a point as to be of minor importance; the rates for the dysenteries are now much lower than was the case in the early years of the occupation; the dengue rates have remained at a consistently high level, but a very radical reduction in these rates may be anticipated in future years; and the rates for tuberculosis in the Philippine Islands are considerably higher than in the U.S. In so far as epidemic diseases are concerned, an extension of the tour of duty will not adversely affect the health of troops except possibly in the case of venereal diseases and tuberculosis, provided the responsible authorities will apply efficiently the known measures for the control of this group of diseases. The rates for other general diseases, such as tumours, rheumatic fevers, nutritional diseases, the anæmias, diseases of the glands, alcoholism, &c., have been lowered, but the reductions made in the U.S. have more than doubled those attained in the Philippine Islands. So far as diseases *per se* are concerned, troops on duty in the Philippine Islands are not now so subject to seriously disabling diseases as was the case in the early years of the occupation, and the present tour of duty (two years) could be prolonged by six months to not to exceed one year without material injury to health and efficiency of the average individual. Prolongation of the tour beyond a period of three years is considered inadvisable, and if extended to two and a half to three years, the regulations governing leave and detached service should be very liberal.

Studies on Urobilin Physiology and Pathology. The Relation of Biliary Infections to the Genesis and Excretion of Urobilin (P. D. McMaster and R. Elman, *The Journal of Experimental Medicine*, June 1, 1926).—Experimental infection of the incubated and previously sterile biliary tract of the dog with particles of the stools leads to a formation of urobilin from the bilirubin of the bile as it flows through the ducts. No urobilinuria occurs, how-

ever, unless temporary biliary obstruction is produced, or the liver parenchyma injured. Then urobilinuria develops, despite the fact that no bile is reaching the intestine and, by corollary, no urobilin being formed there. Cholangitic urobilinuria as one may term the phenomenon just described, to distinguish it from the urobilinuria having origin in pigment absorbed from within the intestine, is far more pronounced in animals possessing a healthy gall-bladder or with one prevented from functioning by severance of the cystic duct. These facts suggest that there may be an active absorption of urobilin from the normal gall-bladder. There can be no doubt that the pigment is absorbed from within the bile ducts. There is no evidence whatever to justify the belief that urobilin is ever formed through the action of the liver parenchyma. There may conceivably be an intralobular formation of the pigment consequent upon the activity of bacteria within the liver tissue, though such a happening has yet to be demonstrated.

The Geographical Distribution of Spontaneous Encephalitis in Rabbits (E. V. Cowdry, *Journal of Experimental Medicine*, June 1, 1926).—The author's observations seem to justify the hope that the obstacle afforded to experimentation by the frequent presence of spontaneous encephalitis and nephritis in American and European rabbits does not exist to the same degree in rabbits from certain other localities. The observations are, furthermore, despite their obvious limitations, in conformity with the theory that the disease is not one common to domestic rabbits everywhere, but rather that it occurs in special localities from which, given favourable conditions, it may spread. Thus far it has not been reported in tropical climates or south of the Equator.

Generalized Alopecia. Report of Three Cases with one Necropsy (G. Wilson and N. W. Winkelman, *Journal of the American Medical Association*, May 8, 1926).—Three cases are cited as examples of generalized alopecia. In the first the condition came on one year after a complete hysterectomy, with the coincident occurrence of symptoms that were due to brain tumour. The fact that removal of the ovaries usually produces hypertrichosis and also that the alopecia did not occur until one year later would militate against the possibility that the condition was ovarian in origin. The situation of the brain tumour directly over the pituitary and in the third ventricle produced erosion of the sella turcica which, with the low blood-sugar and hypotension was suggestive of a disturbance of function in the region of the infundibulum or pituitary, or both. In the second cases, the symptoms came on after severe emotional stress and here, too, there are symptoms referable to the pituitary region, although not necessarily a tumour. It is said by some that emotional stress is incapable of producing such a marked disturbance of a ductless gland, yet exophthalmic goitre has been known to develop in a woman shortly after she had been nearly drowned. Furthermore, the so-called neurocirculatory asthenia or effort syndrome which in certain cases may be of endocrine origin occasionally comes on after severe fright, and in this group of cases disability persists for many years. Other cases of universal alopecia following emotional stress have been recorded; thus Sabouraud described a case of profuse alopecia in a girl aged 13, who lost her hair thirteen days after being raped, although the hair returned later. Boisser, Bidon and Morris have all cited cases of generalized alopecia coming on after severe emotional stress. The cause of the alopecia in the third case is unknown. In this case, as in the second one, various glandular extracts were tried over a period of one year but without results.

Abstract.

SMALL-POX AND CLIMATE IN INDIA. FORECASTING OF EPIDEMICS.[1]

By Sir L. Rogers.

The small-pox incidence in India is greatest and most uniform from year to year in Madras, the only province not receiving much rain during the south-west monsoon months from June to October.

In all the seven provinces receiving the south-west monsoon rains there is a remarkable decline of small-pox every year at that season, followed by an increase during the ensuing cold and hot dry seasons once more checked by the next monsoon In Madras there is no decline of the disease at that season in the absence of the south-west monsoon, and only a very slight fall after the October rains, while the main small-pox rise occurs after the heavy rains of November and December. The rainfall of all three months is derived from the north-west autumn monsoon. Rainfall alone will not, therefore, explain the great fall of small-pox in the rest of India during the south-west monsoon.

The greatest small-pox epidemics occur in the low rainfall areas of north-west India and the central Indian and Deccan plateau, while they are least marked in humid Bengal with consistently high rainfall; the epidemics in the former areas nearly invariably follow a greater or less failure of the south-west monsoon rains, accompanied by comparatively low humidity.

The provincial average small-pox incidence shows no relation to the monthly temperature, and none to the relative humidity in the damp areas of Lower Bengal, Assam and Madras. The absolute humidity (that is the amount of aqueous vapour as measured by its pressure, a convenient measure of combined humidity and temperature) shows a close relation to small-pox prevalence. It rises to its maximum with the annual decline of small-pox during the south-west monsoon in every province receiving its main rain then. In Madras both the

[1] Abstracted from Report No. 106, Medical Research Council, July, 1926.

absolute humidity and the small-pox rate are stationary at that season in the absence of the south-west monsoon, while the maximum absolute humidity occurs as early as April and May and is accompanied by the annual moderate early decline of small-pox. The early winter north-east monsoon rains occur during a fall of the mean monthly temperature and of the absolute humidity, thus explaining their failure to prevent the winter increase of small-pox in Madras. The influence of high absolute humidity in checking small-pox thus suffices to explain its seasonal prevalence in all parts of India with their very varying rainfalls and temperatures.

A map shows increased small-pox with decreased rainfall and absolute humidity in northern India from Bengal to the north-west frontier province; it is especially noteworthy that in the latter area alone is the absolute humidity during the south-west monsoon as low as in Madras, as this is the only climatic feature common to these distant parts of India, and that the small-pox rate is nearly as high.

Records of small-pox case-incidence in Indian jails for thirty years—the data of which are recorded in areas selected for their meteorological conditions—show a very close relationship between high annual humidity and low small-pox incidence, and vice versa, in the whole of northern and central India, once more confirming the influence of humidity.

The effect on the yearly variations of small-pox mortality of meteorological conditions has been studied from monthly charts of the rainfall for forty-eight years, and of the absolute humidity for thirty years, for which they are available for eight provinces of India, and also the yearly small-pox rates and absolute humidities during the monsoon and autumn for thirty years; with the result of showing that in the less rainy areas of the north-west and central India, with average absolute humidity during the monsoon of about 0·700-0·800, low absolute humidity during that period is nearly always followed by excess of small-pox in the ensuing dry seasons; while in the areas with heavy rainfall of Bengal and Assam, as well as in Madras, the absolute humidity during the summer, which is very high, reaching 0·800-0·970, has very little relation to small-pox incidence, but years in which the humidity is low in the autumn, when normally it ranges from about 0·700-0·800, are generally followed by excess of small-pox in the ensuing dry months. The only exceptions are that low humidity soon after a small-pox epidemic, which has exhausted most of the susceptible material, may not result in any increase of the disease; while five or six consecutive years of normal or high absolute humidity may be followed by a rise of small-pox, on account of the accumulation of susceptible persons.

By watching the absolute humidity in India, and possibly in other tropical continental countries, at the season when they normally average about 0·700-0·800, about four-fifths of small-pox epidemics may be foreseen two or three months ahead, in time to enable the public health authorities to issue warnings and to organize additional vaccination staff to cope with and minimize the approaching outbreak of small-pox.

Current Literature.

BULLETIN DE LA SOCIÉTÉ DE PATHOLOGIE EXOTIQUE. *April* 14, 1926.

Spirochætal Pulmonary Affections of Madagascar (E. Tournier).—Certain pulmonary syndromes exist in Madagascar due to Castellani's spirochæte or one very similar. The spirochæte is found in large numbers in the sputum; it is easily stained in watery solutions of fuchsin or methylene blue. It has never been found accompanied by fusiform bacilli or other microbes, and cannot be classified with fœtid bronchitis or pulmonary gangrene. Three different types of clinical syndrome have been observed: (1) Type of hæmorrhagic bronchitis, with abundant hæmoptysis; little or no fever, bronchial râles, slight dyspnœa, rapid cure. (2) Syndrome of pulmonary congestion, shivers, high fever with irregular temperature, well-marked dyspnœa, general condition serious. Moist râles. The mucous expectoration is always hæmorrhagic without presenting the characters or abundance of the hæmoptysis of hæmorrhagic bronchitis. In these cases complications are often observed and diarrhœa is frequent from secondary enteritis due to deglutition of the sputum. (3) Asthma. This affection, very frequent in Madagascar, presents the identical symptomatology of the adult European affection. Spirochætes have been found in the sputum of all the patients suffering from asthma. The specific treatment by arsenicals is very effective. The best method is subcutaneous or intramuscular injections of novarsenobenzol; minimum dose 0·30 cg., injection to be repeated every three or four days. Treparsol has given very good results in a case of asthma; and enteritis responds well to stovarsol and to treparsol.

The Coccidiosis of Domestic Animals in Russia (W. L. Yakimoff).—Several species of Coccidia have been found in the stools of domestic animals of Russia, in the district of Lodeinoe-Pole. Bovine coccidiosis begins in spring and lasts until autumn, and very often terminates fatally. Autopsy shows hyperæmia of the intestine, sometimes rectal ulcerations. Infection is due to drinking from stagnant waters. Coccidiosis of sheep, probably due to *Eimeria faurei*, is frequently observed, and the affection also exists among goats, pigs, fowls and vipers. This is the first report of coccidiosis in Russia.

Coccidiosis of Pigs in Russia (W. L. Yakimoff, W. J. Wassilewsky, E. N. Markoff and E. F. Rastegaieff).—During September and October, 1924, the intestines of 91 animals at Petrograd were examined

for coccidia; 39 were found to be infected. In October and November of the same year, 13 pigs were examined in the Crimea; 5 were infected. The coccidia were ovoid in form, rarely spherical, and resembled *Eimeria stiedæ*. The same forms have been observed by Cauchemez, with a micropyle which was not observed in these cases. The examination of the bile and liver gave no results. Some authors do not believe that these coccidia are pathogenic to pigs; in this paper the authors do not come to the conclusion that they are pathogenic, as the animals were obtained from slaughter houses, but constipation and desquamation of the cells have been observed in infected animals. The coccidia incriminated as the cause of the disease in pigs is *Eimeria debliecki* Douwes, 1921.

The Rôle of Gastric Juice in the Natural Immunity of Rabbits in Coccidiosis (T. A. Kolpakoff).—Coccidiosis in rabbits is very frequent in Petrograd, especially in very young animals. It rages during summer and autumn and the mortality reaches a percentage of 80. These investigations show that the gastric juice of rabbits hinders the sporogony of *Eimeria stiedæ*. The sporogony does not take place in the gastric juice or intestine or in the bile. The very young rabbits are the most susceptible to disease, and the best prophylactic measure is to separate the young ones from the mothers.

The Use of Larvicidal Powders against Mosquitoes (E. Roubaud).—Larvicidal powders have given very good results in these experiments and are considered very promising. Most of them can only be successfully used under favourable conditions. They have many advantages over oils and liquid larvicides against mosquitoes, which are not practicable for using in larger areas and very often render the water temporarily unusable. The powders, being insoluble, cannot contaminate the water and are easily disseminated by the air. The author describes in detail the action of trioxymethylene, arsenical powders and a proprietary substance. The latter is the one most highly recommended against anophelines and culicines, especially for use on a large scale; its action is rapid and lasting and harmless to other forms of life. When used against anopheline larvæ, the powder is spread on the surface of the water; against culicines it must be held in suspension to reach the larvæ feeding below the surface; in each case paralysis of the larvæ ensues, resulting in death. The toxic action of trioxymethylene is not lasting, and applications should be made once a week in hot weather and every ten or fifteen days in cold weather; the applications should not be made oftener than this or the larvæ will become immune to its action through frequent small doses. The disadvantage of this substance is its high cost.

Calcium arsenite, copper aceto-arsenite, arsenic trisulphide and copper arsenite were among the arsenical powders which proved efficacious, but their action does not last longer than that of trioxymethylene.

The proprietary substance, of which the active principle is formaldehyde, has been prepared in a peculiar medium chosen to counteract the effects of moisture, and to increase the floating capacity or the maintenance in suspension of the powder. It is more lasting in effectiveness than the others, and its action is more rapid.

Sleeping Sickness in Portuguese Guinea (J. Sant Ana Barrets).—A first case of sleeping sickness has been recorded in Portuguese Guinea, where *Glossina palpalis* is abundant, but where the disease has not hitherto been observed. The patient was a European who evidently contracted the infection from some immigrant or traveller from equatorial Africa.

Treatment of Sleeping Sickness by Tryparsamide (S. Abbatucci).—Tryparsamide is considered the best medicament in the treatment of sleeping sickness in the second period of the malady, but should not be used during the first stage as it very frequently causes ocular troubles.

The Pathogenicity of "Bouffissure" in Annam (J. Kerandel).—Great importance is attached to the study of this malady, which is somewhat grave and frequent and is the principal cause of mortality in Annam. It has been attributed by various authors to ankylostomiasis, malaria, beriberi, &c. It is characterized by general œdema; the swelling begins in the lower limbs, spreads to the upper limbs and finally the whole of the body is affected. Anæmia is a constant symptom; the liver is atrophied, spleen hypertrophied. When the œdema disappears in the course of treatment the patient becomes extremely thin. Ankylostomiasis is not the cause of this disease, but it aggravates it. This affection is not common to all ages; it is very rare under 12 years, and few cases have been observed in people over 31 years. Syphilis appears to play an important rôle in "Bouffissure," but the real cause of the disease is still obscure.

Medical News.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE.

PRESENTATION TO DR. ANDREW BALFOUR.

MANY members of the teaching staff of the London School of Hygiene and Tropical Medicine and other friends, including Lady Manson, assembled in the library on Friday, July 23, in order to make a presentation to Dr. Andrew Balfour, the Director. The presentation took the form of a picture by Mr. A. O. Lamplough, representing a Sudanese on a camel in a waste of sand. At the same time Mrs. Balfour was presented with a silver rose-bowl as a memento of the occasion. The presentation was made by Professor R. Tanner Hewlett, who said:—

"Dr. ANDREW BALFOUR,—We are gathered here to-day to make you a little presentation as a token of goodwill and esteem in which you are held not only by your colleagues of the School, but by many other outside friends. If you will look at the list of those who have contributed to this presentation you will find that it includes a representative of the Rockefeller Foundation, past and present members of the teaching staff of the School, members of the staff of the Tropical Diseases Hospital, representatives of the Seamen's Hospital Society,

members of the Bureau of Hygiene and Tropical Diseases, and of your administrative staff (and in this connection Mr. Harris writes to say how sorry he is to be unable to be present to-day and how proud he is to serve under you). Many years ago—more years probably than either you or I care to reckon—I had the honour and pleasure of being present at a dinner to bid you farewell on your approaching departure for Khartoum.

"I little thought then—a score of years or more—that I should, in the future, be the unworthy mouthpiece of those who desire, in a sense, to welcome you back again in the important and honourable post of Director of the London School of Hygiene and Tropical Medicine. I need hardly say how glad I am to do this and appreciate the call, though I am bound to say I suspect it is a somewhat dubious compliment to myself based on length of service and grey hairs rather than on actual merit!

"We have now reached what may, perhaps, be regarded as the third stage in the career of the School of Hygiene. The first stage was the noble gift of the Rockefeller trustees of funds for the foundation of the School. The second stage was the altogether admirable appointment of yourself as Director of the School, and the third stage was initiated the other day by the laying of the foundation stone of the permanent home of the School.

"Some of us of the old London School of Tropical Medicine, so successful in the past under the ægis of the Seamen's Hospital Society, to whom a warm tribute ought to be paid for their wisdom and foresight in undertaking so desirable, though at the same time so great, a venture, some of us of the old Tropical School may feel some regret at its disappearance as a separate entity, for, believe me, under the inspiration and leadership of Sir Patrick Manson we throve wonderfully and were a very happy family. But all of us, I think, agree that the incorporation of the Tropical School in the new School of Hygiene was a right and proper step, and we, in particular, members of the old Tropical School, welcome your appointment as Director because we believe that the great Mansonian tradition will be worthily maintained in your hands as regards the tropical side of the School's activities.

"As regards other activities of the School, in your hands, too, we may rest assured that they will be in equally safe keeping. The physical side of health training certainly will, for have you not won, if not spurs, at least many hacks and bruises on university and international football fields? You have experience of public health administration, you have travelled widely and have a broad outlook on health problems, you are a research worker and know the importance of a live school combining teaching with research. When I look at the list of decorations and degrees you have acquired, of the prizes you have won, of the appointments you have held, of the campaigns in which you have taken part, and of the committees upon which you have served, I begin to ask myself: Has Scotland produced only one Admiral Crichton?

"Moreover, by your silver speech and ready pen you do much for the School. Was not the last-named (your ready pen) partially trained in the realm of romantic fiction? We may be sure you will not be 'Cashiered,' may we hope that your course will be a smooth one, not determined 'By Stroke of Sword' nor recourse 'To Arms,' and that in your present post you have in some degree entered into 'The Golden Kingdom.'

"This little gift which we have for you I beg you to accept, firstly, as a welcome (somewhat belated perhaps) to the School; secondly, as an appreciation of all you have done for the organization of the School activities and of the inauguration of its permanent home; and thirdly, as a token of cordial esteem and goodwill from colleagues and other friends. It may also serve to remind you of the time you have spent in tropical climes in the service of humanity and of your country.

"Finally, it is a pleasant supplement to the presentation to yourself to ask Mrs. Balfour, your closest colleague, kindly to accept this rose-bowl as a memento of this occasion."

Dr. Andrew Balfour, in reply, expressed his thanks and those of Mrs. Balfour for the presentations. He referred to the welcome he had received from the Staff of the School who had rendered him all the assistance possible in the task of reorganizing the School. He paid a warm tribute to the great qualities of Sir Patrick Manson, and said that he for his part would do all in his power to maintain the Mansonian tradition.

QUESTIONS OF PRIORITY CONNECTED WITH MALARIA.

Sir Ronald Ross wishes us to announce that he will be glad to show original papers on this subject if anyone interested in them will write to him at the Ross Institute for Tropical Diseases and fix dates for the visit. Some of these publications can apparently be no longer obtained, and seem to be still unknown to various writers on malaria. Any date will suit him if fixed beforehand. The Institute is reached by General Omnibus Service 51 in ten minutes from Putney Bridge Underground Station.

THE GOLD MEDAL OF THE AMERICAN MEDICAL ASSOCIATION.

The Gold Medal of the American Medical Association for 1926 has been awarded to Professor Aldo Castellani for his work on Tropical Mycoses.

New Preparations, Inventions, &c.

Sodium Salts of Tetrabrom-phenolphthalein and Tetraiodo-phenolphthalein.

Burroughs Wellcome & Co. are in a position to supply sodium salts of tetrabrom-phenolphthalein and tetraiodo-phenolphthalein for use in cholecystography.

These salts may be obtained in gelatin capsules for oral administration or in glass containers if intended for intravenous injection. Medical men should state the strength required when ordering.

Medical bacteriologists may be interested to know that Burroughs Wellcome & Co. are in a position to supply sodium salts of the following organic acids: *d*-tartaric, *l*-tartaric, *meso*-tartaric, citric, fumaric and mucic. These agents are now being employed in the differentiation of bacterial types in which "sugar reactions" are untrustworthy or fail altogether. Further particulars may be obtained on application to Snow Hill Buildings, London, E.C.1.

The "Agla" Micrometer Syringe Apparatus.

The accurate instrument for the measurement of extremely minute quantities of liquids, described by Dr. J. W. Trevan in *The Biochemical Journal*, xix, No. 6, p. 1111, is now obtainable from Burroughs Wellcome & Co. It is known as the "Agla" Micrometer Syringe Apparatus and is suitable for the measurement of volumes from 0·5 c.c. (with an error of less than ± 0·1 per cent.) to those as small as 0·001 c.c. (with an error of less than 5 per cent.). In immunological work the instrument can measure volumes of the order of 0·01 c.c. with an error of less than ± 1 per cent.

The "Agla" Micrometer Syringe Apparatus enables a fine degree of accuracy to be attained in various delicate laboratory processes including the following: (1) Immunological titrations with very small quantities of serum. (2) The calibration of pipettes of small volume. For this purpose an ordinary fine hypodermic needle should be used and the required volume injected into the pipette by inserting the needle just inside the end of the capillary. (3) Micro-chemical titrations and micro-gas analyses, in which the instrument may be used as a burette.

Price in London, 55s. complete net. Further details may be obtained from Burroughs Wellcome & Co.

We have been informed that "Santonin" is now supplied in small quantities from ½ oz. upwards, suitable for the Tropics. To ensure its genuineness each package bears a label attractively printed in red and green containing the word "Santoninum" and the name of the exclusive official distributors, The Eastern and Russian Trading Co.

Original Communication.

AIRPLANE DUSTING IN THE CONTROL OF MALARIA MOSQUITOES.[1]

By W. V. King

AND

G. H. Bradley.

For the past three years experiments have been conducted by the United States Bureau of Entomology at Mound, Louisiana, on the use of airplanes in distributing larvicides over the breeding places of malaria-carrying mosquitoes. This work has been carried out with the co-operation of the Delta Laboratory, of the Bureau at Tallulah, Louisiana, and the Air Service of the United States Army. The planes used had been equipped for cotton dusting and were provided with metal dust hoppers installed in the rear cockpit, with an opening through the bottom of the fuselage for the release of the dust. The hoppers were designed to hold a load of 300 pounds of material and the rate of delivery could be varied by means of a sliding valve adjustment.

The possibilities of using planes for this purpose was suggested when it was found that Paris green applied as a dust was highly effective in destroying the larvæ of this particular kind of mosquito. These larvæ have the habit of feeding at the surface of the water and skim their food from the surface film. Paris green, although heavier than water, will float, due to the surface tension, long enough to be taken up by the larvæ along with their food. Since only a minute quantity is required to kill each larva

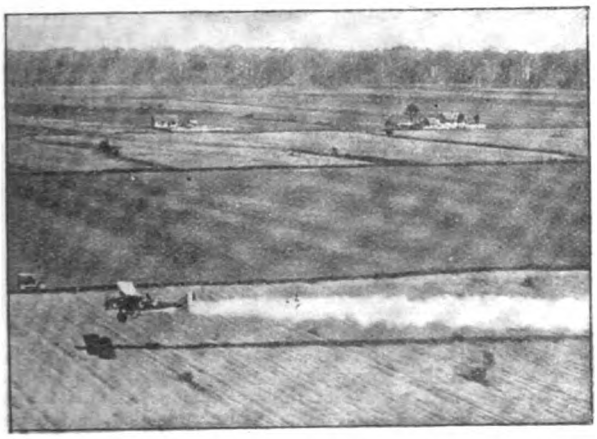


Fig. 1.—Dusting plane flown across open field to determine the spread of the Paris green and dust mixture under the most favourable conditions. Plane flying about 15 ft. above ground.

it is not necessary actually to poison the water, and for this reason fish are not injured and there is little or no danger from the drinking of treated water by domestic animals. Unfortunately, other species of mosquitoes which feed below the surface film are not affected, but in most of the malarious regions the other mosquito pests which are troublesome about the houses are not produced in the large swamp areas. Their breeding places are the water barrels and cisterns, ditches and small pools near

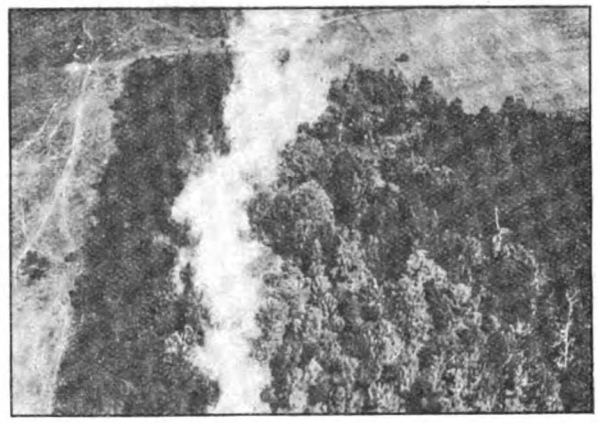


Fig. 2.—Dust cloud beginning to spread out among trees following a trip of the plane across Bienkiem Woods.

the dwellings which would not be subject to airplane treatment.

Because of the small quantity of Paris green required, an inert dust of some sort is used as a diluent and carrier. This is found to be quite necessary to secure thorough distribution without using an excessive amount of the poison. A variety of substances have been employed by ourselves and others, including ordinary road dust, sand, cork dust, calcium carbonate, diatomaceous earth, a mixture of lime and flour and an amorphous silicous dust known as Tripoli earth. These materials differ considerably in density and fineness of grain which affect distribution and especially the distance of drift. In most of our experiments we have used the Tripoli earth because of its availability and uniformity. It also had an advantage over the lighter materials in treating breeding places protected by trees, since its heavier weight caused it to settle more quickly.

The mixtures used for airplane distribution contained from 5 to 20 per cent. Paris green, 10 per cent. being the usual proportion. Under average conditions a ½ pound of Paris green per acre, or 5 pounds of the 10 per cent. mixture was taken as the basis for estimating the amount of dust to be used. This gave a leeway for a certain amount of wastage resulting from wind drift and adherence of the dust to the leaves of aquatic vegetation. Where the breeding places were protected by a heavy growth of brush and trees the amount of dust had to be considerably increased. On the other hand, where there was little vegetation above the water surface a much smaller quantity was required. The amount put

[1] Published by permission of the United States Bureau of Agriculture, given to Sir Ronald Ross.

out on a given area could be regulated by the opening of the hopper valve and by the distance between successive trips of the plane. Some substances fed out two or three times as fast as others, and this had to be taken into consideration in making the valve adjustments.

In effectively treating swamp areas careful attention had to be given to the drift of the dust cloud. In the early experiments the dusting was tried in the early morning when the air is usually still, but

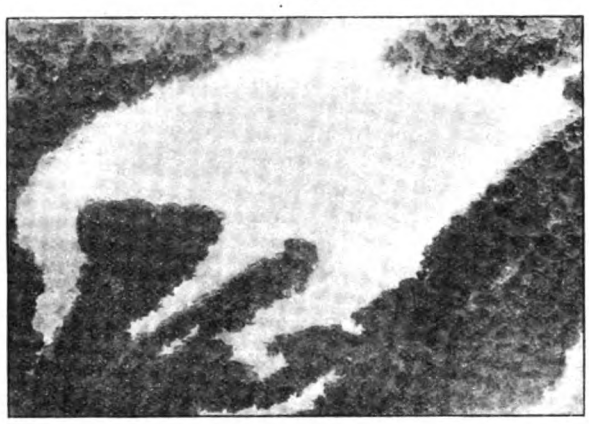


FIG. 3.—One of the larger swamp lakes.

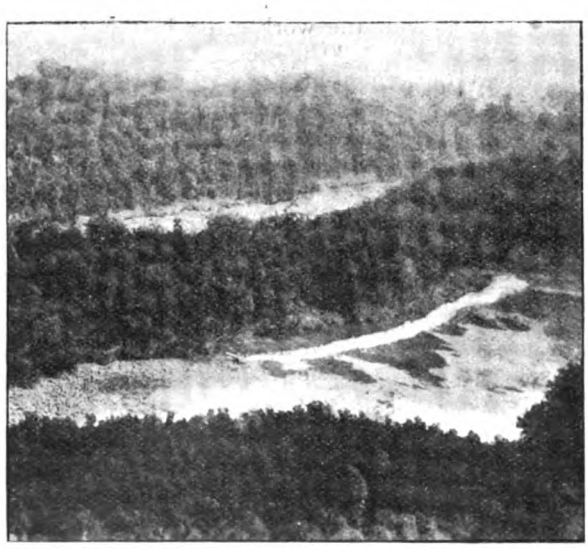


FIG. 4.—Dusting plane making flight over the centre of St. Via Lake, flying below the tops of the trees on each side.

the presence of dew on the leaves at this time of day proved to be a serious drawback, since it caught the dust particles and prevented their reaching the water surface. By the time the leaves become dry there is almost always more or less wind, but it was found that, with proper handling of the planes, a slight breeze was often of advantage in helping to distribute the dust. Occasionally, however, the wind at this time of day would be too strong for successful dusting and the operation would have to be postponed.

The shallow swamp lakes in this region consist usually of a central treeless area containing a growth of water-lilies and a variety of smaller aquatic vegetation favourable for mosquito breeding. Around the margins the water spreads out during a part of the season into a thick stand of brush and tall willow

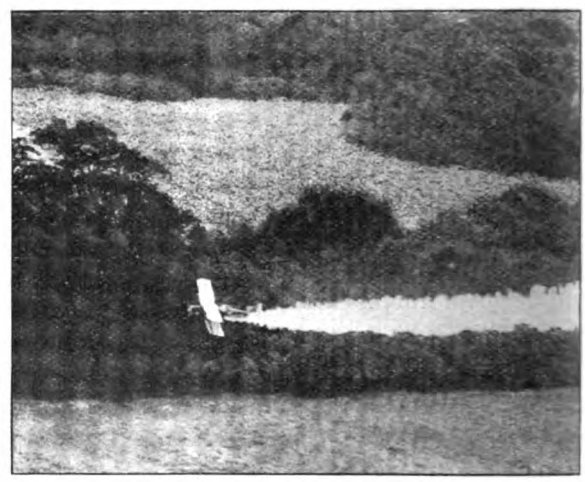


FIG. 5.—Dusting the marginal zone of Field Lake with the wind blowing towards the lake; the plane was flown outside of the tree line and the dust drifted into the breeding area.

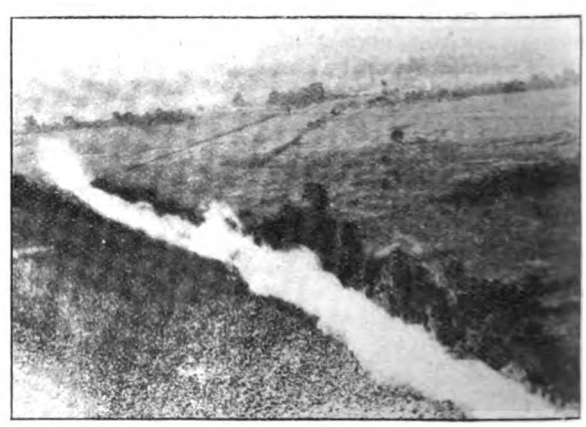


FIG. 6.—View of another dust cloud left in treating the marginal zone of Field Lake. In this case the plane was flown on the lake side of the trees, since the drift was towards the open field. The photograph also shows the heavy growth of water chinquapui, in a portion of the lake, completely obscuring the water surface.

trees. With a skilful pilot no especial difficulty was encountered in successfully treating the central portion, even when the lily growth was so thick as almost to obscure the water surface. The treatment of areas protected by brush and trees was a much more difficult proposition and the results under these conditions were

quite variable. When such breeding zones were comparatively narrow the application could be made by flying the planes on the windward side of the tree line and allowing the dust to drift in from the side. Where the area was larger it was necessary to fly directly over the tree tops, but even in such places the dust was found to penetrate the thick growth provided a sufficient quantity was used to offset the greatly increased wastage.



FIG 7.—Growth of water chinquapui in Blue Tuoret Lake at time of dusting test in 1924.

In work of this kind the greatest item of expense is, of course, the operation of the airplanes, but only approximate figures as to cost can be given at the present time. This matter has been discussed at length with representatives of the Huff, Daland

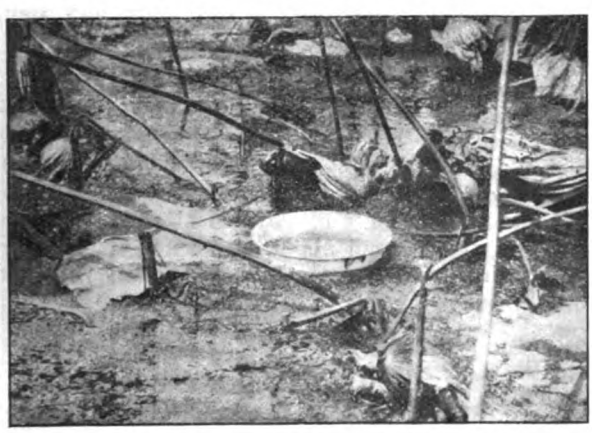


FIG. 8.—One of the pans containing larvæ and floating on the surface of the water, as used in the lake dusting experiments in 1924. The view also shows the water conditions encountered during these tests.

Aero Corporation, who undertook commercial cotton dusting against the boll weevil during the past season. The estimates arrived at have varied from fifty cents to about one dollar per acre, including the cost of poison. With a unit organized solely for lake dusting, a large acreage would have to be included to make the proposition feasible, and the cost would probably approximate the higher figure. However, if the work is carried out in conjunction with a cotton-dusting unit it is believed that the actual cost would be from fifty to sixty cents per acre on the average. This would provide an economical method of distribution were it necessary to make only a few applications. Unfortunately, Paris green remains effective on the water for only a very short time, and where mosquito breeding is continuous it is necessary to re-apply it every eight or nine days to prevent the emergence of adults. Consequently, the cost runs up rapidly over a period of several months.

As compared to any method of hand distribution, however, it is believed that, even under present conditions, the cost would be much in favour of airplanes on an area large enough to justify their use. Moreover, there are many swamp breeding places which it would be almost impossible to treat either from the ground or from boats.

During 1922, an experiment on the control of anopheles breeding areas by means of the hand distribution of diluted Paris green was undertaken by the Public Health Service, in the vicinity of Lake City, Florida. Figures published by Mr. T. B. Hayne, in charge of the work, showed that the cost of twelve applications to an area of approximately 475,000 square feet was $773 for labour and poison—a rate of about $5.90 per acre per application. Mr. Hayne estimated that, from the experience gained, the work could be repeated at a reduction of 20 to 30 per cent. in cost, and this would possibly represent the expense of such work under average conditions.

The use of temporary methods of malaria control such as poisoning and oiling are not, of course, employed except where drainage or other permanent measures cannot be undertaken at the time. The expense which would be justified in a control campaign in any community depends upon the size of the population affected and the severity of malaria infection. Even with these limitations, it is believed that a certain number of malarious locations are to be found where the distribution of Paris green by means of airplanes could be economically employed, and the opportunities would be materially increased by any reduction in the cost of airplane operation or by some improvement in the larvicide, so that the number of applications required would be reduced.

THE CAUSE OF THE HAIRLESSNESS OF MAN.

By H. N. RIDLEY.

AT the recent meeting of the British Association, Dr. Gunther read a paper on the above subject in which he suggested that the loss of hair on the body in man was due to the invention of fire, the nude varieties of man attacking and exterminating the hairy races with flaming brands which fired the body hair. This theory does not

appear to me at all a probable one, as I think that in a fight with fire between a nude man and a hairy one, the fire would injure the exposed skin more than one covered with hair, the hair acting to some extent as a protection. It is true that my large mias (orang outang) *Simia satyrus*, which lived so long in the London Zoological Gardens, rather objected to lighting his cigarettes with a match (though he knew well enough how to strike one and light the cigarette), as on some occasions the head of the match in striking it flew off into his beard and burnt him, but he would regularly light his own cigarette from a lighted one offered to him, and evidently knew how to handle fire in this way.

I would point out that Mousterian man, who was certainly hairy all over, knew how to make and handle fire, as Mousterian hearths have often been found, and we know that the much later Magdalenian man was also hairy and used fire.

A suggestion often made is that the loss of hair was caused by the wearing of clothes. This is easily disproved by the fact that the wild tribes who habitually go naked or formerly did so, such as the Sakais of the Malay Peninsula, and the Moi of Annam, are unusually hairless, much more so than the thickly-clad European, and that the head and pubes, the first portion of the body to be covered, are the most hairy parts.

I have two suggestions to make as to the cause of hairlessness of the body.

Some years ago, in my menagerie at Singapore, I had an adult female mias, and after I had her for some little time, I observed that after menstruation she lost almost entirely the hair from the abdomen and chest, quite suddenly. There was no signs of any skin disease to account for it, and in a short time the hair grew again. Some months later the same thing happened; I concluded that the reason of the hair-fall was to prevent the clotting of the hairs by milk should she breed. Unfortunately, I had no adult male, and some time after she died from the usual choleraic diarrhœa which is so fatal to these apes in captivity. The main nudity appeared from the chest to the lower part of the abdomen.

In the representation of the pregnant woman of Magdalenian age from Laugerie Basse, as figured in Sollas, "Ancient Hunters," p. 550, fig. 311, the hair is shown on the abdomen and outer side of the thighs and axilla only, not on the breast, in fact, mostly below the navel, very much as it appeared in the mias when on heat, though she was denuded rather lower. This denudation, so far as I have seen, does not occur in *Hylobates* nor in the lower monkeys, but in these the fur is short, close and dense, not so long and loose as it is in the mias. I have kept a number of *Hylobates* and they never bred in captivity. The fall of the hair in the breeding season in the female would not, of course, account for the denudation of the male, but it may have been a start in the permanent hairlessness of the body.

The second suggestion is that the loss of hair all over the body is due to injury caused by skin vermin, fleas or lice. It is not uncommon for oriental natives to shave the head in children, especially to get rid of lice. It is not difficult to keep free from such vermin when the hair is confined to the head and pubes, but it would be very difficult to do so if the body was entirely covered with hair. Now lice of themselves would not cause mortality among the tribe, but if one may conceive them as acting as propagators of disease of a dangerous character, it might be fatal to a tribe to be covered with them in long hair which could not be cleaned. We know now that both fleas and lice do carry deadly diseases, e.g., plague and typhus, trench fever and relapsing fever.

Is it not possible that when primitive man became herded together, living in close contact, some disease such as those mentioned might spread so as to exterminate all those who were thickly covered with hair? It must be noted that the common monkeys, and still more the anthropoid apes, live together in small detached families and not only would any such disease be less readily communicated from one to another, but in a small family of three or eight, the usual number in anthropoid and lower simians, it would be easy to keep each other clean. Monkeys of all kinds are peculiarly free of skin vermin owing to their habits of incessantly searching for them. Epidemic disease is the outcome of the crowding together of animals in communities. Primitive man, as far as is known, lived in small groups or families which had no constant or close communication with other groups, as the Sakais of the Malay Peninsula do at the present day; later they increased and formed communities. An invasion of a race bearing some disease-carrying parasite might infect and exterminate any hairy race, leaving only those who, being less furnished with hair on the body, could clean off the vermin.

I may point out that the era of the hairy Magdalenians was followed by the invasion of the neolithic Azilian race, who appear, from their introducing wheat, to have come from the East, and to have also brought with them the rat (R. Munro, "Palaeolithic Man," p. 251) so closely associated with the plague, and about this time all the hairy Palaeolithic men appear to have completely vanished.

REFUTATION OF STATEMENTS MADE BY PROFESSOR R. T. LEIPER, M.D., D.Sc., F.R.S., CONCERNING AFRICAN SCHISTOSOMES, "AMERICAN" GONGYLONEMAS, ZOO VERMIN AND ITALIAN CANCER HOUSES.

By Louis W. Sambon, M.D.

Lecturer in the London School of Hygiene and Tropical Medicine.

Not without regret, I have to reply to Professor R. T. Leiper, M.D., D.Sc., F.R.S., my colleague in the London School of Hygiene and Tropical Medicine, who has attacked my recent epidemio-

logical, helminthological and phytological researches on cancer.

The *Times*, in its issue of July 14, 1926, said: "One of the most interesting communications in the report (the *Annual Report for* 1925 *of the British Empire Cancer Campaign*, July, 1926) came from that brilliant investigator, Professor R. T. Leiper, whose work on Egyptian bilharziosis is still fresh in the scientific mind. Dr. Leiper, by a series of very careful studies, has disproved once more—and this time perhaps finally—of the theory of 'cancer houses,' even in its most scientific form. The theory was revived some time ago as the result of Fibiger of Copenhagen's discovery that cockroaches played the part of host to a worm capable of causing cancer in rats. The cockroach as a carrier of agents of human cancer has been acquitted by Dr. Leiper."

The report mentioned in the *Times* is entitled "Some Observations and Reflections on Recent Attempts to Implicate the Gongylonema Worm in the Causation of Cancer in Man," by Professor R. T. Leiper, M.D., D.Sc., F.R.S.

I will deal first with some of the facts concerning Egyptian bilharziosis.

Now, it happens that, no less than seven years before Professor Leiper, I demonstrated clearly that there were, in Egypt, two different species of blood-flukes affecting man: (1) *Schistosoma hæmatobium* Bilharz, 1851, affecting the urogenital system and giving rise to endemic hæmaturia; (2) *Schistosoma mansoni* Sambon, 1907, affecting the large bowel and producing dysenteric symptoms. The most striking morphological difference between these two species, the one most easily seen and of diagnostic importance, lies in the armature of their ova: the egg of *Schistosoma hæmatobium* being provided with a terminal spike, whilst that of *Schistosoma mansoni* bears a lateral one. Lack of material and the bad preservation of the two female specimens I had the opportunity of examining, prevented me from indicating any morphological differences in the build of the adult worms, but I brought forward a wealth of evidence to show that, though sometimes associated, in overlapping distributional areas, the two species differed markedly in their geographical range and topographical distribution. Further, notwithstanding the failure of numerous investigators (Cobbold, Sonsino, Lortet, Vialeton, Looss) to find any molluscan, arthropod, or piscine intermediate host, and rejecting the opinion of Professor Looss, which denied the necessity of any intermediary (as previously surmised by Professor Grassi in the case of *Schistosoma bovis*), I pointed out that these schistosomes, like other digenetic trematodes, necessarily must have gasteropod intermediate hosts. These statements were by no means negligible guesses, but inevitable conclusions derived from well-ascertained facts, from suitable analogies and from a correct interpretation of extant knowledge. Indeed, eminent helminthologists, such as Professors Blanchard, Railliet and Brumpt in France; Stiles, Ward and Lutz in America; Drs. Low, Chalmers and Castellani in this country, at once accepted my views.

Professor Looss, on the other hand, opposed me bitterly and it was on the occasion of his second diatribe that Professor Leiper, taking advantage of the very first number of a journal issued by our school (see *The Journal of the London School of Tropical Medicine*, Vol. 1, Part 1, December, 1911), wrote these memorable words:—

"In a highly interesting communication Prof. Looss brings to a close, it is to be hoped, the recent controversy upon the significance of the 'lateral spine' sometimes met with in eggs from cases of African bilharziasis. He conclusively demonstrates that Dr. Sambon's 'species' and his own 'hypothesis' are untenable."

What followed?

Keen Japanese scientific workers (Miyagawa, Miyairi, Suzuki, Ogata), between 1910-14, made a thorough investigation of their own particular form of schistosomiasis—a disease long known in Nippon under the name of "Katayama disease" and due to the parasitism of *Schistosoma japonicum* Katsurada, 1904. They proved that, as I had suggested for the African schistosomes, the Oriental blood-fluke has a gasteropod intermediate host—the Katayama snail *Katayama* (= *Hypsobia*) *nosophora* Robson 1914, and that its cercaria—a fork-tailed larva—dropping its bifid swimming appendage and drilling its way through skin or mucous membrane, can successfully infest man, dog, cat, ox, horse, hog or field-mouse.

In 1914, Professor Leiper went to Japan, where he had the opportunity of studying and verifying the work of the Japanese investigators and learning their ingenious methods. Then he proceeded to Egypt and there, of course, had no difficulty in confirming my statements of 1907, which he had so "hopefully" repudiated in 1911. Professor Leiper was forced to recognize that, in the land of the Sphinx, there are two species of schistosome affecting man, each producing a differently formed egg and that their miracidia do penetrate fresh-water snails, each species choosing, as I had predicted, a particular kind of gasteropod: *Planorbis boissyi*, in the case of my new species *Schistosoma mansoni*, and *Isidora truncata* (olim *Bullinus contortus*), in that of the old species *Schistosoma hæmatobium* described by Bilharz in 1851.

In his lecture on bilharziosis, delivered at the Royal Society of Medicine in 1916, Professor Leiper said: "Manson had always maintained that the lateral-spined egg, having a different geographical distribution (*sic*) and producing normally dysenteric symptoms only, was the product of a different species. This view was strongly supported by Sambon, who maintained with great skill a vigorous polemic against Looss's position. Sambon was forced to regard the adult parasites as practically indistinguishable in the absence of reliable details."

These acknowledgments are neither full nor correct. Manson had *not* always maintained that the schistosome producing a lateral-spined egg was

specifically different from the one producing a terminal-spined egg. Indeed, in 1902, when I examined one of his patients helminthologically and found lateral-spined schistosome eggs instead of necator or ankylostoma eggs, as suspected, in an anæmic Englishman from the West Indies, invalided home by Dr. Branch, of Antigua, we discussed the case and I insisted on regarding the lateral-spined egg as evidence of a separate species, yet Manson published this case in the JOURNAL OF TROPICAL MEDICINE (December 15, 1902) as one of *Bilharzia hæmatobia* and said: "In this case, as often happens in bilharzia ova from the alimentary canal, the spine is placed laterally." In this article on the Antigua case there is no allusion whatever to a separate species which, according to Professor Leiper, "Manson had always maintained," but ample evidence to show that then he had not accepted my view of the matter.[1] At that time I was helping Manson to prepare the third edition of his "Manual of Tropical Diseases," and, forcibly struck by this sufferer of intestinal schistosomiasis who had been nowhere else abroad than in the Caribbee Islands, where endemic hæmaturia is unknown, I continued to discuss the subject and urged Manson to suggest the probability at least of two different species. Manson then wrote: "Possibly there are two species of bilharzia, one with lateral-spined ova, depositing its eggs in the rectum only; the other haunting bladder or rectum indifferently." In his Lane Lectures, published two years later (1905), still diffident, he says: "It may be that in this difference in the position of the spine in vesical and rectal bilharziosis we have an indication of difference of species." Finally, after I had proposed definitely myself the form with lateral-spined egg as a separate species (*Proceedings of the Zoological Society*, March 9, 1907), Manson fully recognized the duality of species and in the fourth edition of his book (August, 1907) wrote: "This case (Antigua case, 1903) led me to think that probably the lateral-spined ova indicated a distinct species of schistosomum, and I suggested this in a previous edition of this manual and elsewhere (Lane Lectures)." Further, he says: "Sambon, having had the opportunity of comparing specimens of the type characterized by lateral-spined ova with *Schistosoma hæmatobium* and other schistosomidæ, and taking into consideration its peculiar geographical distribution and distinct pathogeny, proposed that it should be ranked as a distinct species, and paid me the compliment of naming it *Schistosoma mansoni* in recognition of my suggestion." In the preface to his manual Manson says: "I desire especially to acknowledge my obligation to Dr. L. Sambon for much assistance in bringing the zoological information and nomenclature up to date." Professor Leiper must have known all this, but, doubtless, he had forgotten.

Now let us consider Professor Leiper's attack on my cancer work.

After the publication of my Paris lecture at the Institut Pasteur, on the "Epidemiology of Cancer" (JOURNAL OF TROPICAL MEDICINE, February 2, 1925), Professor Leiper took up the study of the part helminths might play in the perplexing labyrinth of cancer ætiology and commenced, as I had done, by taking up the thread-worm Gongylonema. Indeed, one day, last year, at the London School of Tropical Medicine, he told me that he was going to Villa Lagarina (one of the Tridentine villages I had chosen for research work on account of the peculiar limitation of cancer to one section only—practically one street—during the last half century). "Why not join us in our work?" I asked, though, at the time, I thought he was not serious.

Whilst in Italy, I learnt that Professor Leiper and Dr. T. W. M. Cameron, M.R.C.V.S., were in Milan collecting specimens of gongylonema in the municipal slaughter-house. Later, I read that Professor Leiper had obtained a grant for this purpose from the British Empire Cancer Campaign.

After my return home, The British Empire Cancer Campaign, which financed our expedition, informed the Committee of the Tropical Disease Prevention Association, under whose auspices I had been working, that Professor Leiper had been asked to examine our helminthological material. Although this request seemed unusual—that Dr. Baylis, helminthologist in the British Museum, and myself, lecturer in the London School of Tropical Medicine, should place our material and unpublished reports in the hands of an investigator who, to their knowledge, was working on the same subject and who had followed us to the same country for the collection of his material, yet, in accordance with our agreement and fully relying on the fairness of the British Empire Cancer Campaign, no demur was made.

Soon after, at a meeting of the Zoological Society of London, held on June 1, 1926, under the presidency of Sir John Bland-Sutton, Bart., F.R.C.S., Professor Leiper read a paper on "Some Parasites of Rats in the Zoological Society's Gardens." Under cover of this title, Professor Leiper launched an attack on the results and views of Dr. Baylis and myself, notwithstanding that not only our published but our unpublished reports also had been placed in his hands.

Sir John Bland-Sutton, vice-chairman of the British Empire Cancer Campaign, supported the speaker and stated that one should be grateful to any person who came forward to test unfounded theories, especially in the case of cancer, and thus prevent the public being misled. These words were widely reported in the lay press. Thus the *Westminster Gazette* (June 2, 1926) wrote that Professor Leiper, of the School of Tropical Medicine

[1] An earlier West Indian case from Martinique had been described by Professor Maurice Letulle as presenting both lateral and terminal-spined eggs, and was so considered by pathologists and helminthologists until I pointed out that the short terminal-spined eggs in Letulle's sections were microtome artefacts. "If a lateral-spined egg is sectioned obliquely at the base of the spine and in a line with the axis of the spine, it is manifest that the resulting figure would be an oval with a spine at one end of the long axis."

had "exploded Dr. Sambon's theory" and that he was "preparing a damning report."

This report was considered by the Grand Council of the British Empire Cancer Campaign at their meeting held at the House of Lords, on July 12, 1926; it formed part of the Campaign's annual report and was submitted to the press.

Finally, it is necessary to state that, whilst the Grand Council of the British Empire Cancer Campaign formally approved the publication of Professor Leiper's report, already printed and incorporated in their annual report for 1925, they again delayed the publication of my report, notwithstanding Leiper's attack and the fact that it had been over six months in their hands. They referred it to yet another committee!

At length, on July 20, 1926, the secretary of the Campaign wrote that his committee did not feel justified in objecting to our association communicating to some scientific journal the results of our investigations in Italy, but hoped that, having read and considered Professor Leiper's report, which was cordially endorsed by the Campaign, our association would give consideration to the views contained in that report.

The following is a careful consideration of Professor Leiper's "Observations and Reflections" (published in the *Annual Report of the British Empire Cancer Campaign*, 1926) on my recent cancer investigations.

Professor Leiper begins his paper with a quotation which he seems to have borrowed from my Paris lecture. I had quoted words of the late Dr. E. F. Bashford, Director of the Imperial Cancer Research Fund, who, anathematizing "cancer houses," had said: "Let us hope that the danger of cancer houses will cease to alarm the public and divert the energies of investigators from *fruitful* lines of inquiry." Professor Leiper, in his accurate manner, has substituted the word "futile" for "fruitful."

This misquotation is followed by a chaplet of short sentences culled from my paper and strung on a twist of extraneous words, a method purporting to present the opponent's views in his very words, but often misrepresenting them through omission, transposition or interpolation. I do not suggest that such is wilfully the case in the present instance, but I do wish to deprecate this objectionable method.

At the end of his quotations, Professor Leiper remarks that "Dr. Sambon has revived in a definite form the old cancer house theory." This is quite correct, but not so what follows.

I never "assumed," as Professor Leiper gratuitously asserts, "that in the old houses—especially in cancer houses—rats harbouring *Gongylonema neoplasticum* 'occur,'" nor did I state, as he again advances, "that man 'can' be infected with this gongylonema, which hitherto has been found only in the rat."

Certainly, and for good reason, did I think that it would be desirable to find out whether rats or mice infested with *Gongylonema neoplasticum* did occur in or near houses where cases of buccal, œsophageal or gastric cancer had occurred, and I did think, and still do think, that the rat gongylonema may be capable of infecting man; since experimentally it is easily transmitted to the most diverse animals such as mice, guinea-pigs, rabbits and sheep. So far, however, as stated in my report, I have not found rats infested with *Gongylonema neoplasticum* in any of the Italian villages which I have had the opportunity of visiting, and as to the form of gongylonema hitherto found in man, I stated that this in Italy, as in the United States of America, was probably the one believed to be peculiar to the pig and called *Gongylonema pulchrum*.

This brings us to the section entitled Discussion. Here Professor Leiper states that, from a study of my "published" reports and of the subsidiary publications by members of the staff of the British Museum who accompanied me, he is forced to the conclusion that:—

(1) No evidence is forthcoming that rats in Italy are infested at all with *Gongylonema neoplasticum*, which he declares is a parasite of tropical America and the West Indies.

(2) The natural intermediary host of *Gongylonema neoplasticum*, the American cockroach (*Periplaneta americana*), does not appear to have become established in Italy.

(3) No case of *Gongylonema neoplasticum* was found in man.

Conclusion 1 is perfectly true, indeed it is on the strength of our own negative evidence that Professor Leiper states that we did not find *Gongylonema neoplasticum* in any of the rats we were able to capture at Villa Lagarina and other Trentino villages. But the rats examined by us were few in number and neither Baylis nor I would accept this as proof that *Gongylonema neoplasticum* does not occur in Italy.

At the foot of conclusion 1 Professor Leiper makes a very definite statement, he says:

"Here it may be remarked that *Gongylonema neoplasticum* is a parasite of tropical America and the West Indies, and has never been found in Europe save in warehouses or other buildings connected with the importation of sugar or other commodities arriving by ship from these regions."

Considering the cosmopolitanism of rats and their notoriety as wanderers, together with the same cosmopolitan habits of the "ship cockroach" (*Periplaneta americana*), recalling also that other Blattidæ (*Blatta orientalis* and *Blattella germanica*) and certain beetles such as meal beetles (*Tenebrio molitor* and *Tenebrio obscurus*) are able to foster the larval stages of *Gongylonema neoplasticum* I fail to understand Professor Leiper's rashness. Indeed, had I not read it in the "Annual Report of the British Empire Cancer Campaign," I should not have believed that Professor Leiper could have devised, written and published such a statement.

In the first place *Gongylonema neoplasticum* (or forms indistinguishable from it) has been described

from various parts of Europe and Asia. Thus Yokogawa (1925) has described what appears to be the same form from Formosa, under the name *Gongylonema orientale*, and states that there, as in Europe, it gives rise to cancroid growths in the stomach of rats. In 1924, Dr. R. E. Schulz described yet another form from mice in South Russia and Turkestan. Unable to differentiate this gongylonema from *Gongylonema neoplasticum* and, fully aware of the fact that great variability is characteristic of this genus, Schulz jokingly suggests the provisional name *problematicum* and states that his presumptive species cannot be distinguished from *Gongylonema neoplasticum* and *Gongylonema musculi*.

The very first species of gongylonema described was a mouse gongylonema collected in Austria by Rudolphi, in 1819, and named by him *Filaria musculi*. Rudolphi, as I have shown, confounded two different parasites of the mouse, one the gongylonema found "*Circa ventriculum*," the other, *Hepaticola hepatica*, found "*in hepate*." In 1845, Dujardin had the opportunity of examining a female specimen of Rudolphi's *Filaria musculi*, sent from Vienna to the Paris Museum; it measured 21·6 mm. in length by 0·154 mm. in thickness. It presented two lateral membranous alæ in the anterior portion and its ova measured 45 microns in length, by half that size in width. He thought these characters suggested a *Spiroptera*. In 1857, R. Molin examined Rudolphi's *Filaria musculi*, established for it the genus *Gongylonema* and called it *Gongylonema minimum*.

Both Baylis and I have described a female specimen from the house-mouse which we could not distinguish from *Gongylonema neoplasticum*; it was collected with other specimens by Dr. Wassink in an Amsterdam sugar refinery said to be free from rats, but no doubt infested with cockroaches. Wassink's specimens showed that *Gongylonema neoplasticum*, under natural conditions, can develop perfectly well in the house-mouse.

In 1914, Seurat described under the name of *Gongylonema brevispiculum* a gongylonema found in the dwarf jerboa (*Dipodillus campestris*) in Algeria which Maurice C. Hall believes to be identical with *Gongylonema neoplasticum*.

Need I say that *Gongylonema neoplasticum* has been found in several northern countries such as Holland and Denmark and that it was in Copenhagen that Professor J. Fibiger first noticed its association with gastric carcinoma in rats?

The above facts, all published and accessible to the helminthologist, are incompatible with the statement made by Professor Leiper that *Gongylonema neoplasticum* is a parasite of the neotropical region and has never been found in Europe, save in warehouses or other buildings connected with the importation of sugar or other commodities arriving by ship from these regions.

This statement was made by Professor Leiper at the very time when, while controlling our researches, he accidentally discovered *Gongylonema neoplasticum* in England, in the rats and cockroaches of the London Zoological Gardens, not in a sugar refinery, nor in anything connected with sugar, but in the reptile-house, where they have existed and swarmed unmolested for at least half a century, because, in 1868, writing in *Science Gossip*, "H.C.R." says that *Periplaneta americana* occurs in warehouses near the Thames, in Red Lion and Bloomsbury Squares, and the Zoological Gardens, Regent's Park. Professor Leiper, in the paper he read at the Zoological Society of London on May 11, 1926, stated that he had found malignant neoplasms associated with *Gongylonema neoplasticum* in the few Zoo rats he had examined, and this ominous statement, so contrary to the views he was expressing, was reported in the lay press. But with this I shall deal elsewhere.

Nor is this all. Every zoologist knows that true rats and mice (indeed, the whole of the murine sub-family) belong to the Old World and, probably, the same may be said of the so-called American cockroach. Walsh doubts the American origin of *Periplaneta americana* and suspects its importation from Asia.[1] "This species," he says, "does not appear to hail from South America and has followed the trade routes over nearly all the world." Is it conceivable then that, as Professor Leiper naively

[1] Because of the absurdity of Professor Leiper's mistake, I have thought it necessary to corroborate my own evidence by authoritative statement. Thus, with regard to the distribution of rats and mice, I am able to quote Mr. Martin A. C. Hinton, a distinguished mammalogist in the British Museum, who writes: "The subfamily Murinæ is without doubt of Old World origin. South-eastern Asia is probably to be regarded as the original home of the group. From this centre the Murinæ have spread outwards during Tertiary times, so that the natural range of the subfamily now extends throughout the whole of Asia, and includes the Australian region, Europe and Africa. It arrived in Eastern Africa after the separation of Madagascar, and in North-eastern Asia and North-western Europe after the destruction of the bridges between the Old and New Worlds. In Madagascar and the American continent therefore no trace of any living or fossil member of the subfamily, indigenous to those countries, has ever been discovered. In quite recent times, however, rats (*Rattus rattus* and *Rattus norvegicus*) and the house mouse (*Mus musculus*) have been conveyed by human commerce to all parts of the world. The three species in question are undoubtedly of Asiatic origin, although they now enjoy a secondary cosmopolitan distribution."

Concerning the cockroaches, I consulted Mr. B. P. Uvarov, of the Imperial Bureau of Entomology, and he kindly wrote: "R. Shelford (Genera Insectorum, 109 fasc., *Orthoptera, Blattidae*, subfam. *Blattinae*; 1910; p. 17) refers to the genus *Periplaneta* 37 species (discounting 3 doubtful species). Of this number only *three* are not known in the Old World, the rest being either purely Old World species, or species of cosmopolitan distribution (like *Periplaneta americana, australasiæ* and *truncata*). Two of the New World species (viz., *fuliginosa* Serv. and *insignis* Serv.) have not been sufficiently well studied to be certain that they really belong to this genus, and the only species of *Periplaneta* known from South America and not recorded from the Old World is *Periplaneta brunnea* Burm. This evidence seems to indicate that the genus *Periplaneta* is of Old World origin."

states, *Gongylonema neoplasticum* could be a New World parasite peculiar to Old World hosts and that it is confined to America and the West Indies, while the numerous scientists who have found it and described it from the most sundered parts of Europe and Asia, wherever rats and cockroaches do congregate must all have been mistaken? So remarkable a phenomenon in parasitology has hitherto not been imagined by the multitude of lesser helminthologists!

Not only is the rat Gongylonema an Old World parasite, but the genus Gongylonema itself is certainly of Old World origin. Gongylonema occurs in domestic swine and cattle on the American continent, but, so far, it has never been found in any wild American animal.[1] True swine (*Suidæ*) are confined to the Old World and domestic pigs were not introduced into America before the seventeenth century. Bovines are undoubtedly of Old World origin, the bison and its extinct relatives being comparatively recent immigrants into the New World, which they reached by way of Behring Strait, formerly an isthmus.

But are we quite sure that *Gongylonema neoplasticum* is a good species? So far, the only character by which it can be distinguished from the gongylonema of cattle, pigs and man is the smaller relative size of the left spicule, and that feature, like every other character in *Gongylonema*, is an exceedingly variable one.

With regard to conclusion 2, I believe it can be assumed that *Periplaneta americana* is unknown in the Trentino, but on the other hand *Blatta orientalis* and *Blattella germanica* are exceedingly common, while both are known to be able to foster the larval stages of *Gongylonema neoplasticum* and *Gongylonema scutatum*.

The answer to conclusion 3 is that we had practically no opportunity of looking for gongylonema in man. If we consider *Gongylonema neoplasticum* a separate and good species and not a variety or mere synonym of *Gongylonema pulchrum*, then, as it was not found in the local rats and cockroaches examined, it was unlikely to be found in man. But as the name we give a parasite, whether we consider it species, variety or host-race, of much importance? What I think important is the fact that I was able to establish the presence of *Gongylonema* in Europe as an occasional parasite of man, first by exhuming it out of literature, where it lay buried under the name of *Filaria labialis* Pane 1864, then tracking a case described by Professor Alessandrini twelve years ago (1914), but which had escaped the notice of helminthologists and is not mentioned in that thesaurus of helminthological information which is the American index-catalogue of medical and veterinary zoology. I found this patient, accompanied her, with her physician and Dr. Pan, to the various places where she had resided, and determined the locality where infection had occurred. Finally, through Professor Alessandrini's courtesy, Baylis and I were able to see, examine and compare with other specimens the worms extracted from beneath the girl's tongue.

Professor Leiper's three conclusions are followed by a summary of some of the parasitological work carried out in Italy by Dr. Baylis with the assistance of Dr. Pan and my daughter, Miss Juliette Sambon. Then follows the misleading suggestion that I ascribed to *Gongylonema* infestation the occurrence of "cancer houses" and "cancer villages" in Italy, and Professor Leiper says: "There has been complete failure to correlate gastric carcinoma with the occurrence of gongylonema in rats and vermin in the so-called 'cancer houses' and 'cancer villages' in Italy."

Continuing in the same manner, he says: "This occurrence of gongylonema in stock in the neighbourhood of the so-called 'cancer villages' has now to be considered in its possible relationship to human cancer in these villages."

He mentions the village of Villa Lagarina and implies that Dr. Ciurcentaler, by saying: "I have discovered in Villa Lagarina important epidemiological facts which confirm in every way your theory," alludes to gongylonema, while, instead, it refers to my infection theory generally. Then he says:—

"The rats, house vermin and the parasites of stock in this village were very intensively studied. The only cockroaches found there were identified by the British Museum as *Blatta orientalis*.

"These results seem of themselves to provide sufficient evidence that gongylonema cannot be the cause or explanation of the alleged frequency of gastric carcinoma in Villa Lagarina. In this village the cases are limited practically to the houses in a single street. The only cockroach found in the village is *Blatta orientalis*, which, as stated by them, cannot be experimentally infected with the cattle gongylonema. The other species of cockroaches —*Periplaneta americana* and *Blattella germanica*—which can act as carriers of the rat and cattle gongylonema respectively, were not found there. Finally, although the cattle gongylonema was experimentally transmitted by them to laboratory-bred rats by feeding these on dung-beetles, no naturally infected rats were found in the village, nor were dung-beetles found in the houses or cow-sheds. There is no reason to suppose that rats which might have become infected with *Gongylonema pulchrum* in the fields would return only to the so-called 'cancer houses.' Even if they did so, no effective intermediary has been found awaiting them there to transmit the infective stage to man."

[1] In his work on "Nematode Parasites of Mammals of the Orders Rodentia, Lagomorpha, and Hyracoidea," Maurice C. Hall lists a *Gongylonema* (?) *species* Hall, 1916, found in the stomach of *Castor fiber* from the United States (? Michigan), but, as he states, this is merely "a tentative assignment," based on nothing more than the following words: "In the stomach of the beaver I have found a very fine filamentous worm 40″ in length, species unknown," (in a footnote to Morgan's work on the American beaver, 1868). Hall says: "The fact that this worm was very fine, 3½ in. long, and located in the stomach, suggests that it might be a species of Gongylonema." The distinguished American helminthologist certainly beats me in boldness, yet I fear he is wrong. *Hepaticola gastrica* Baylis 1926, not known when he wrote, is likely to be a better guess. In any case, the beaver, though widely distributed throughout the Holarctic region, had its origin in the Old World. It inhabited the English fens, from Pleistocene times, and was found as late as the sixteenth century in Wales.

Twice Professor Leiper tells us that "the only cockroaches found in Villa Lagarina were identified by the British Museum as *Blatta orientalis*." Yet, I had stated quite clearly in my report that "Notwithstanding the absence of gongylonema in the mice and rats we were able to capture in Villa Lagarina, we carefully examined cockroaches (*Blatta orientalis* and *Blattella germanica*), cellar-beetles (*Blaps lethifera*) and meal-worm beetles (*Tenebrio molitor* and *Tenebrio obscurus*), but invariably with negative results." Our entomological material was determined on the spot, or after our return, by Mr. K. G. Blair, of the British Museum, who was a member of the commission. The various domestic species of cockroaches, however, are not difficult to identify. One may need a specialist to determine fleas, but lice and other animals fond of man and his ways, even poets, such as Quintus Serenus and Robert Burns, can diagnose and describe.

With regard to my alleged attempt to "correlate the presence of gongylonema in man with cancer houses and cancer villages in Italy," I need but quote verbatim the statements made in my report.

After mentioning striking peculiarities in the topographical distribution and visceral location of cancer, I said:—

"They forcibly suggested an infection of specific nature, probably dependent for its transmission and development on intermediary agencies with like distribution and, if animate, with correlative bionomics. Therefore I proposed making in Villa Lagarina and other suitable villages a comparative study of the flora and fauna of houses with and without cancer cases in order to find out whether household pests such as fungi, cockroaches, cellar-beetles, meal-worms, bed-bugs, rats or mice were present, and whether they played any part in the incidence of the disease, or if any parasites, fostered by house vermin, might be concerned."

At the beginning of my parasitological considerations, I said:—

"Because in previous reports I had discussed at some length the part played by certain helminths (*Cysticercus fasciolaris, Opisthorchis felineus, Schistosoma hæmatobium, Oxyuris vermicularis, Trichinella spiralis, Gongylonema neoplasticum*, &c.) in the ætiology of tumours, it was suggested that, in the course of my epidemiological investigations in the Trentino, I should endeavour to ascertain whether any parasitic worm, fostered by house-vermin during its earlier stages, might not later become a factor in the production of cancer in man, or in domestic animals harbouring its adult forms."

With regard to gongylonema, I said:—

"As stated in previous reports, researches made by Dr. Baylis and myself in Italy during the autumn of 1924 had elicited the fact that gongylonema was present in the cattle, sheep, goats and hogs of the provinces of Bologna, Ravenna and Trento, though with greatly varying prevalence in the different animals examined and in the different districts visited.

"We did not go to Villa Lagarina solely to study gongylonema; our object was to endeavour to find out, if possible, why cancer showed peculiar limitations in its topographical distribution, why it affected certain houses or groups of houses, leaving others in the vicinity untouched.

"Suspicion having fallen, since long ago, on rats, mice, blackbeetles, churchyard-beetles and other vermin infesting old buildings, it was our purpose thoroughly to investigate these house pests and anything else that might explain well-ascertained restrictions of the disease to particular streets, blocks of houses, or isolated cottages.

"As stated, we found no gongylonema in the rats, mice, cockroaches, cellar-beetles and meal-worm beetles in Villa Lagarina, but the number of mice and rats examined was, unfortunately, very meagre. On the other hand, we found gongylonema rampant in the local cattle and dung-beetles. Swine we were unable to examine, because none were being slaughtered at the time, but, from our researches in neighbouring localities, we know that they do harbour this nematode parasite when pastured.

"The absence or great rarity of gongylonema in household vermin, its restriction to cattle and dung-chafers, whilst necessarily minimizing the importance of any part it might play in the incidence of cancer in Villa Lagarina did not exclude it. Indeed, if Dr. Baylis is right in assuming identity between swine and cattle gongylonemas, the local cattle harboured that very form (*Gongylonema pulchrum*) which has been reported from man both in Europe and America."

In a previous report (JOURNAL OF TROPICAL MEDICINE, February 2, 1925), I said:—

"For obvious reasons, I have spoken at length of *Gongylonema* and of its intermediary hosts, but I should not like it to be inferred that I give exclusive importance to it, for, in truth, it is only one of several animal parasites which may be concerned in the complex ætiology of cancer."

Finally, I must point out that in all my reports I have stated most emphatically that "whatever be the rôle of parasitic worms, the actual essential cause of cancer is some ubiquitous micro-organism, probably a filter-passer, as the researches of Rous and his fellow-workers seem to indicate." Dr. Gye's recent investigations have brought further confirmation of this view.

That Professor Leiper, in the face of these explicit statements, could report that I endeavoured to explain the cause or frequency of gastric carcinoma and the occurrence of "cancer houses" by gongylonema infestation is difficult to understand.

"We agree with Dr. Baylis," says Professor Leiper, "that these domestic animals (cattle and swine) will have to be considered as important reservoirs of the parasite found in man, for it is evident that gongylonema in man is the species which normally occurs in pigs, but we cannot accept his further conclusion that 'if Dr. Sambon's theory receives confirmation,' then they have to be considered 'as factors in the spread of carcinoma,' for none of the gongylonemas found in domestic stock are associated with the occurrence of cancer in these animals, nor has cancer been observed in any of the cases in which gongylonema has hitherto been recorded in man."

The fact that hitherto cancer had not been found associated with gongylonema in man is in no way surprising since, up to date, only six cases of infestation with gongylonema have been reported, all in young people. The worms, usually immature forms, were discovered in these cases, because they had wandered into the lining of the buccal cavity. Hitherto, gongylonema has not been looked for in the œsophagus post mortem, this organ being very seldom examined.

With regard to cattle and pigs, it must be observed that these food-animals are slaughtered when comparatively young and that gongylonema infesta-

is usually overlooked. Thus when Dr. Baylis and I visited Italy (Trentino, Romagna, Bologna) in 1924, we found that, though exceedingly common in sheep, oxen and swine, gongylonema had escaped detection by the abattoir veterinarians.

Professor Leiper conveniently overlooks my statement that "Examination of the gullet of cattle infected with gongylonema often revealed papillomatous growths in the form of nodular, villous or coralline prominences, but I have no reason to suppose that they were necessarily dependent on the presence of the worm. I have seen identical proliferations of the papillæ and their overlying epithelium in gullets of cattle without gongylonema and in animals bred in districts apparently free from this parasite."

I could have made much of these papillomatous growths, which closely resemble the precancerous excrescences observed in tarred mice, and no doubt I should have done, but purposely made only passing mention of them. Likewise, whilst I considered that Baylis' views as to the identity of the cattle and swine gongylonemas and the extremely close relationship between these and the rat gongylonema were based on sound morphological and biological grounds, I still treated them as separate host-races lest I might too readily interpret evidence in favour of my own views.

Professor Leiper's contention that, of the very doubtfully distinct species *Gongylonema pulchrum*, *Gongylonema scutatum*, *Gongylonema ransomi*, *Gongylonema subtile*, *Gongylonema hominis*, *Gongylonema neoplasticum*, *Gongylonema orientale*, *Gongylonema musculi*, *Gongylonema brevispiculum* and *Gongylonema problematicum*, the only one capable of giving rise to cancer is *Gongylonema neoplasticum*, as if the production of malignant tumours were the true specific character in the absence of any other, is a strange mistake. A new species of *Hepaticola*, found by us in the stomach of Italian rats and described by Dr. Baylis, also gives rise to malignant neoplasms, just like many other nematodes, cestodes and trematodes, provided that the essential specific cause of cancer be also present.

The most remarkable part of Professor Leiper's paper is the section in which he deals with his own experimental work. He begins by telling us how he obtained specimens of gongylonema from cattle and sheep in the Milanese slaughter-houses, and informs us that "*The eggs from these worms* were brought back to England for experimental work." But he does not mention the type of egg-case or hatching-egg package used!

"The object of the experiment," he says, "was to establish, or disprove, the suggestion put forward by Baylis that the species of gongylonema found in stock in Italy was probably identical with that peculiar to the rat, the morphological differences being due to the influence of the host."

Dr. Baylis, as a systematist, being unable to find any definite morphological peculiarities, save very variable differences in size, between several of the hitherto proposed species of *Gongylonema*, was necessarily obliged, in a revision of the group, to reduce the number of previously accepted species. He recognized, however, the influence of particular hosts and the formation of adaptive host-races which, *after long restriction to the same host-species* may, and often do, develop changes sufficiently marked to sanction the establishment of new varieties or even incipient species. With regard to *Gongylonema neoplasticum*, he states his position very clearly:—

"Careful search has been made for some other morphological character in either sex that would enable *G. neoplasticum* to be definitely separated from the forms found in other hosts, but the results, so far, have been entirely negative. In every character studied the amount of individual variation is so great that the specimens from the rat usually fall between the extremes met with in specimens from other sources. . . .

"It is, therefore, a very difficult question whether *G. neoplasticum* should be considered a distinct species or not. It appears to depend upon the importance to be attached to a single character, limited to the male sex, viz., the length of the left spicule. Many helminthologists would, doubtless, consider this quite sufficient to constitute a 'good' species. The writer feels, however, that in view of the amount of variation possible in the forms from other hosts, and until a much larger number of males of *G. neoplasticum* has been examined, the evidence is rather strongly in favour of specific identity. This view does not, of course, exclude the possibility of the existence of a 'host-race,' or even an incipient species, confined to rodents. As in the other cases previously discussed, the question calls for careful experimental investigation by those able to undertake it."

And Professor Leiper made the experiment; an experiment which, no doubt, will be remembered long among helminthologists, biologists and physicians.

"If Baylis's opinion were well founded," says Professor Leiper, "it should have been possible to infest *Periplaneta americana* and then produce, in rats fed with these infected cockroaches, typical examples of the rat *Gongylonema neoplasticum*."

With this conviction, Professor Leiper began to feed his American cockroaches on the eggs brought back from the land of Columbus, maybe the very kind which on a previous occasion had stood on end! Then it was found that not only the cockroaches fed on Italian imported eggs, but the controls also, were stuffed with gongylonema worms, as though the very idea of the experiment had infected them.

The discovery that the cockroaches and the rats inhabiting the Gardens of the Zoological Society of London were naturally infested with *Gongylonema neoplasticum* may have suggested that time and money had been wasted in Italy, but, the necessary material being actually swarming at the "Gardens", it was decided to "attack the problem from another angle."

The new experiment, even more amazing in conception, shows a decided Solomonic touch.

"A further batch of cockroaches was secured, and those cockroaches found to be naturally infected were then split longitudinally into halves. These were fed respectively to sheep and laboratory-bred rats. Two series of experiments on these lines were made.

"In each series positive results followed both in sheep and rats. In the first series seventeen adult gongy-

lonemas were recovered from the rats and one from the sheep. In the second series four adults were found in the sheep and four also in the rats."

These the experiments, now the judgment.

"If Baylis's presumption had been correct, the worms developed in the rat would have differed from those developed in the sheep, in those morphological characters which distinguish the forms found naturally in the rat and those found naturally in the sheep and which have been regarded as the specific characters differentiating *Gongylonema neoplasticum* and *Gongylonema scutatum*. On the other hand, if his view had been incorrect we would have found that the forms developed in the rat and those developed in the sheep were morphologically identical, and identical too with the species naturally infesting the rat from which the cockroaches had acquired the infection utilized in the experiment."

Unfortunately Professor Leiper does not tell us which are the several "specific characters" by means of which he can distinguish *Gongylonema neoplasticum* from *Gongylonema scutatum*. From his "careful measurements" limited to the spicules, we may conclude that he knows no others.

"It follows then," says he, "that *Gongylonema neoplasticum can* develop under exceptional conditions, in sheep, but when it does so it can still be morphologically distinguished from the species of *Gongylonema scutatum*, which is the normal parasite of these animals."

Is it really possible that Professor Leiper goes to the trouble actually of making experiments to find out whether *Gongylonema scutatum* can change instanter to *Gongylonema neoplasticum* on visiting a rat, as he assumes that Dr. Baylis thinks? Could Professor Leiper really have thought that Baylis or I or anyone else could ever believe that a worm, well advanced in development (for such is a rat gongylonema arrived at the third and infective larval stage within its intermediate host), might turn into a different species the moment it found itself swallowed by the wrong host? Such transmutations do appear to happen at conjuring entertainments, but not in nature.

Thus ends this "valuable report" which the British Empire Cancer Campaign published in their Annual Report for 1925, and which the Scientific Advisory Committee of the Campaign "cordially endorse."

But why this attack?

In his retort to Dr. Baylis's letter, in the *British Medical Journal*, September 11, 1926, Professor Leiper says that his grant and ours were made at the same time, "with a wisdom and purpose I do not need to concern myself to discuss."

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SEPTEMBER 15, 1926.

THE NATURE OF THE BACTERIOPHAGE

In an investigation into the nature of ultramicroscopic viruses carried out in 1915, Twort showed that on inoculating agar tubes with glycerinated calf-lymph and incubating them for 24 hours

at 37° C., watery-looking areas often developed, whilst in some of the tubes colonies of micrococci were obtained, and it was found that some of the colonies of the micrococci could not be subcultured and that if kept they became glossy and transparent, presenting a watery appearance. Young normal colonies, when inoculated with this material, developed a similar condition, whilst older colonies were more resistant and dead colonies were unaffected. On passing this watery material through Berkefeld filters, the filtrate, even after dilution a millionfold with water or saline, was capable of producing the same effect. The active agent was thermolabile, being destroyed at 60° C. Stock cultures of *Staphylococcus aureus* and *albus* were slightly affected in this way, whilst streptococci, tubercle bacilli and yeast remained unaffected. The ætiological agent could be promulgated from culture to culture for an indefinite period, continuously increasing in amount, whereas in the absence of living cultures it was incapable of propagation. Similar observations were also made with some intestinal bacteria.

Concerning the nature of the agent responsible for these phenomena, Twort made several interesting suggestions, namely, that the active material might be produced by the micrococcus, that the "virus" might be an ultramicroscopic organism, pathogenic for bacteria, that it might be living protoplasm which formed in definite individuals, or that it might be an enzyme with the power of growth.

The original communication of Twort excited little attention until 1917, when d'Herelle published the results of a similar investigation under the more effective title, "Sur un Microbe Invisible Antagoniste des Bacilles Dysentériques." d'Herelle considered that he had obtained from the stools of patients convalescent from bacillary dysentery a definite ultramicroscopic organism which was actively antagonistic to the dysentery bacillus of Shiga. He found that inoculation of young broth cultures of Shiga's bacillus with this ultramicroscopic organism growth of the culture was inhibited and the turbid culture became clear, the bacilli already present being dissolved. Further, the invisible micro-organism grew and multiplied, as it could be passed from culture to culture of the bacilli without losing its potency. In the absence of living bacteria it could not be propagated. When agar plates were spread with suspensions of the Shiga bacillus mixed in proper proportion with the invisible microbe, clear spots appeared in the film of bacterial growth. When first isolated the ultramicrobe was virulent for the Shiga bacillus only, but later acquired virulence *in vitro* for other bacteria. Lastly, although itself harmless to animals, this microbe was yet capable of rendering animals inoculated with it resistant to the action of the Shiga bacillus. Hence d'Herelle concluded that his active agent is an ultra-microscopic organism, giving to it the name *Bacteriophagum intestinale*: and that it constitutes our chief defence against infection by pathogenic bacteria.

The substance or agent obtained by Twort and that obtained by d'Herelle showed such similarity in their actions, namely, in bringing about the destruction and lysis of growing bacteria whilst itself increasing in amount in the bacterial cultures, that there can be little doubt that they were dealing with similar if not identical things.

The active agent has since been found to be widely distributed in nature, though it has chiefly been obtained from the intestinal tract of man and animals. Pathological tissues, exudates, bacterial cultures, soil and water, have also been employed as sources for the bacteriophage. It can only be propagated in living bacterial cultures, all attempts to propagate it in the absence of living growing bacteria having failed. From a study of the relationship between the multiplication of the bacteria and the increase in the bacteriophage, it has been concluded that the bacteriophage is a product of bacterial growth, rather than of bacterial disintegration.

The action of the bacteriophage upon bacteria may be summed up as follows: When exposed to the action of the bacteriophage many bacteria become phagogenic. Where grown in the presence of the bacteriophage the virulence of many organisms is altered, the cultural properties of the bacteria and the character of solid colonies may also be altered; the antigenic properties of bacteria may be modified by the bacteriophage, and the bacteria are killed and lyed.

The organisms most sensitive to the bacteriophage are the members of the typhoid-dysentery-colon group; less susceptible organisms include the diphtheria bacillus, the plague bacillus, the bacillus of hæmorrhagic septicæmia, staphylococci, streptococci, and the cholera vibrio. Variation in virulence is a marked characteristic of the bacteriophage, whilst it is extremely stable to influences like heat and chemical reagents. The bacteriophage also possesses antigenic properties and various antibodies can be obtained such as precipitins, agglutinins, and opsonins by appropriate manipulation. Lastly, its use as a prophylactive and curative agent has been recommended by d'Herelle.

As to the essential nature of the active agent two views have been held, namely, the original suggestion of d'Herelle, who claimed that it is an ultramicroscopic living organism capable of preying on living bacteria, as implied in the term bacteriophage, and the other that it is a ferment or catalytic agent for which Káteshima suggests the name "Ferment d'immunité bacteriolysant."

At the present time, however, it does not seem possible to arrive at a definite conclusion regarding the nature of the active bacteriophagous agent, and much yet remains to be learned about it before we can accept the original ultra-microbic hypothesis of d'Herelle as being thoroughly established.

F. E. T.

Annotations.

The Mechanism of Daughter Cyst Formation in Hydatid Disease (H. R. Dew, *Medical Journal of Australia*, April 24, 1926).—Daughter cysts in a typical hydatid cyst have an endogenous origin only. They usually arise by progressive evolution of the cells of the original germinal membrane or from brood capsules. More rarely they may develop from scolices. Their formation may be regarded as an expression of the powers of persistence of the parasitic cells. From thin-walled daughter cysts having the typical origin granddaughter cysts may arise in another way. This method consists of an external herniation of both layers at weakened parts of the laminated coat with secondary exclusion of the pouch. This is a rare method. Exogenous daughter cyst production from intracuticular nuclear masses, as usually described, does not occur. In secondary omental cysts, in bone and in the viscera of herbivora, peculiar cysts form which are due to external herniation of both layers with secondary closure and cyst formation, such herniations being dependent on the nature of the adventitious tissues.

Secondary echinococcosis is a well established condition and may occur in the abdomen, in the pleura or in operation wounds as the result of implantation of daughter cysts, brood capsules or scolices. Hydatid emboli and metastases can occur after intravascular rupture of cysts with carriage of brood capsules or scolices by the blood-stream and their survival and growth in new situations. This is the explanation of most cases of multiple cysts of the lungs, heart and brain.

Susceptibility and Resistance to Trypanosome Infections. Attempts at Immunization with Dead and Attenuated Trypanosomes (I. J. Kligler and I. Weitzmann, *Annals of Tropical Medicine and Parasitology*, June 24, 1926).—On account of technical difficulties experienced in collecting large amounts of trypanosomes with the primitive apparatus available, these experiments had to be temporarily suspended. Enough work has been done, however, to indicate that trypanosomes suspended in Bayer "205" behave quite differently from those suspended in saline, and that the animals so treated, instead of becoming hypersusceptible, develop a resistance quite distinct from that induced by the same quantity of the drug alone. The experiments reported give a clue to the nature of some of the pathological changes noted in trypanosome infection, at least in so far as they manifest themselves in experimental animals. The mechanism of the disease is evidently a complex one. First there is the unexplained mystery of the appearance and disappearance of parasites in the blood-stream, then there are the late manifestations of the disease, varying from mild swelling and œdema to severe ulceration and necrosis. In animals artificially sensitized swelling of the ears and eyelids occur promptly after the infection simultaneously with the invasion of the circulation. In normal animals swelling occurs only late in the disease, the fourth or fifth week; or, in other words, after the animal has become spontaneously sensitized by the absorption of the parasites or their products. The œdema and swelling noted in the later stages of the disease are, therefore, direct effects of the parasite and its products. If, however, the condition of treatment is varied and the trypanosomes are injected together with the drug "Bayer 205," an exactly opposite state is established in the animals; they manifest an increased resistance which in some of them may suffice to ward off an infection. This acquired resistance is not attributed to the protective action of the drug. The same phenomenon has already been observed in infected animals treated with "Bayer 205." It would appear that the drug combines in some way with the trypanosome cell producing a heterogenic antigen capable of stimulating the formation of specific antibodies. This may possibly be a demonstration of the type of a combined chemico-immuno-therapy supposed by Yorke to occur in malaria patients treated with quinine. The action of both quinine and "Bayer 205" is not, however, purely germicidal; associated with this property there is apparently also an immunizing activity which completes the cure and affords an increased resistance of greater or lesser duration to subsequent infection. Whether or not artificial immunization would result from the treatment of suitable animals with Hæmosporidia and quinine remains to be determined; the experiments reported suggest that animals may be rendered more resistant to trypanosome infection if treated with a mixture of trypanosomes and "Bayer 205."

Erysipelas. Observations on the Etiology and Treatment with Erysipelas Antistreptococcic Serum (K. E. Birkhaug, *Journal of the American Medical Association*, May 8, 1926).—Further experimental evidence is advanced to prove that the ætiologic agent in erysipelas is a specific type of *Streptococcus hæmolyticus* and that the serum produced with this specific type of micro-organism possesses very marked curative properties when administered early in the disease. Clinical trials in sixty moderately severe cases of erysipelas have demonstrated that intramuscular injection of erysipelas antistreptococcic serum, in amounts of 100 c.c. of the unconcentrated and from 15 c.c. to 20 c.c. of the concentrated serum, when administered during the first three days of the disease causes a prompt amelioration of toxic depression, a critical fall in temperature and pulse-rate, prompt fading of the erysipelatous lesions, and rapid absorption of the blebs and œdema within the affected areas. In late cases of erysipelas, the result of serum therapy is strikingly favourable in ameliorating the general toxic depression, although repeated injections of serum may be necessary completely to neutralize the circulating toxin in the patient's blood. Following each injection of the serum there is noted a critical drop in temperature and pulse to within normal limits from twelve to eight

hours after the injection of the serum; the symptoms may quickly return and a second dose may be necessary to bring about a complete recovery. By means of a skin test dose of toxin infected intradermally and simultaneously with the intramuscular therapeutic dose, it is possible to observe whether complete neutralization of the circulating toxins is accomplished or whether an inadequate dose of serum was administered to the patient to accomplish the cure of the disease. It is too early to state whether the serum is purely antitoxic in nature. Its influence on the rate of recurrence of erysipelas in patients having frequent attacks of the disease is also of great interest and will be studied further. It is hoped that serum sickness following the administration of large doses of antistreptococcic serum will be less severe and less frequent when refined globulin serum is used.

The Rôle of the Reticulo-Endothelial System in Immunity (C. W. Jungeblut and J. A. Berlot, *Journal of Experimental Medicine*, May 1, 1926).—Following massive doses of indian ink injected intravenously into guinea-pigs before a subcutaneous injection of diphtheria toxin-antitoxin mixture, no antitoxin was found in the blood-serum for three weeks, as indicated by intracutaneous tests, whereas an appreciable amount could be detected in non-blocked, immunized control animals. During the fourth week following immunization, the titre of the serum of blocked animals equalled that of non-blocked controls within the limits of the intracutaneous test dose. The smaller doses of India ink used in these experiments, given before immunization, had no stimulating effect on the production of diphtheria antitoxin, but, on the contrary, also inhibited the appearance of this antibody, although to a less extent.

The Relation between Atherosclerosis and Ingested Cholesterol in the Rabbit (S. Clarkson and J. H. Newburgh, *Journal of Experimental Medicine*, May 1, 1926).—The range of free cholesterol in the blood of rabbits, as determined by the Windaus method, varies from 35 mg. to 125 mg., with a mean of 71 mg. per 100 c.c. of blood. The small amount of cholesterol contained in the high protein diet used in earlier work and causing the atherosclerosis does not affect the blood-cholesterol nor does it cause arterial disease. In order to produce atherosclerosis it is necessary to feed at least ten times that amount of cholesterol. In rabbits receiving such amounts both hypercholesterolæmia and atherosclerosis occur, but it is not possible to establish any close parallelism between the two. High blood readings are found in rabbits with normal aortæ and atherosclerotic rabbits in this series sometimes have shown a normal blood-cholesterol. With still greater doses of cholesterol one finally reaches an amount which regularly produces hypercholesterolæmia and atherosclerosis within a few weeks. A new series of rabbits fed upon the high protein diet shows that those rabbits which become atherosclerotic also develop hypercholesterolæmia. This elevation of the blood-cholesterol is attributed to a metabolic disturbance directly referable to the excess of protein in the diet and not to its cholesterol content.

Studies on Pneumococcus Growth Inhibition (S. T. Wood, *Journal of Experimental Medicine*, May, 1926).—Employing a method described in an earlier publication for testing the pneumococcidal activity of serum-leucocyte mixtures, a study has been made of the pneumococcus-destroying properties of the blood of a relatively susceptible animal, the rabbit, for pneumococci of low virulence for the species. It was found that rabbit-leucocyte mixtures possessed the power to kill avirulent pneumococci in relatively large numbers, but failed to inhibit the growth of virulent organisms even in minute quantities. The results of numerous experiments in which all three types of pneumococci were employed indicated that the ability of a strain of pneumococcus to grow in rabbit blood is dependent on its virulence for the rabbit. The extreme susceptibility of the very young rabbit to strains of pneumococcus of low virulence for the full-grown animal was found to be associated with an absence of pneumococcidal properties in the blood of the young rabbit. These findings suggest that the relatively susceptible animals possess the same type of defence mechanism against pneumococcus infection as do the highly pneumococcus-resistant species.

A Study of the Incidence of Kala-azar in Certain Parts of North Behar (D. F. Micheal, *Indian Medical Research Memoirs*, February, 1926).—Kala-azar appears to be endemic in the District of Darbhanga and Muzaffarpur. Certain villages appear to be definite foci of infection, notably the villages of Rampur Bakhri, in the Muzaffarpur district and possibly also Mahespur, in the same district, and Mahamada, on the north side appears to be fairly heavily infected; exemplifying "site infection." Lack of conservancy, defects in domestic and personal hygiene and the presence of dirt in and around the houses are apparently definitely connected with the prevalence of the disease. The institution of hygienic measures in an infected area combined with the treatment of cases of the disease seems to lessen the incidence in a striking manner. The disease is most prevalent when humidity is prevalent and markedly less during dry weather. Children and young adults to a slightly lesser extent show the greatest degree to susceptibility to the disease. A point of interest is the comparative immunity to the disease which people of the sweeper class seem to enjoy. Not a single case has, to the author's knowledge, occurred amongst either the hospital sweepers or the Pusa Estate Conservancy Estab-

lishment or their families during the past four and a half years, while children of other servants in attendance on the sick in hospital have contracted the disease.

Current Literature.

THE AMERICAN JOURNAL OF TROPICAL MEDICINE, *May*, 1926.

Mosquito Species Control of Malaria (S. T. Darling).—These investigations were carried out in October, 1916. A preliminary field survey of a region where there was very severe endemic malaria in the rice fields of the Tjihœa Vlaagte showed that *A. aconita*, the anopheline carrier of the malaria, did not breed in the water of the rice fields which were under cultivation, but in neglected grassy irrigation ditches and grassy sodden rice paddies which were lying fallow. Based on these facts a notable reduction in the amount of malaria was made by instituting special regulations requiring the people regularly to clean and burn the irrigation ditches and to lay dry their rice fields after harvest, also to regulate the amount of water used for irrigation purposes avoiding its excessive use. It is suggested that every malarial problem should in like manner be defined first by field studies, for the actual breeding areas may be small and relatively easy to control, and it may be possible economically to use specific measures directed against all mosquitoes, and in this way avoid the unnecessary expenditure of time and money which has been not an uncommon feature of malarial control measures in many places.

The Prevalence and the Distribution of the Yellow Fever Mosquito Ædes ægypti (Linn.) in Venezuela (L. H. Dunn).—During the spring of 1925, twenty-six cities, towns and villages in various parts of the northern half of Venezuela were visited, and inspections were made to determine the extent to which the breeding of the yellow fever mosquito was occurring. The system of water supply and other conditions having potential influence on the breeding and distribution of this species were also inspected. In practically all the places visited, the system of water supply was found to be of such a nature as to necessitate the use of numerous containers, tinajas, ornamental fountains, barrels, ollas, pilas, filter stones, tanks and others, for water storage in the house, thus providing conditions favourable for the breeding of domestic mosquitoes in the habitations. In the better class houses of fifteen of the cities and towns there was a piped water supply, but in only one town, San Cristobal, was the supply sufficient to provide running water in the houses at all hours of the day and night. The other eleven towns and villages depended for their supply on rain water, wells and nearby rivers. In fourteen of the places visited, water was being sold in the streets by vendors. In all 3,506 houses were inspected and 10,229 water containers. No *Ædes ægypti* breeding place was found in three of the towns, the others were all positive.

The Occurrence of Quartan Malaria in the Low Coastal Regions of the State of Rio de Janeiro, Brazil. An Epidemiological Study (N. C. Davis and M. F. Boyd).—Studies within certain areas within the low coastal region of the State of Rio de Janeiro, Brazil, have revealed a very small number of infections with *Plasmodium malariæ*. Reasons are given for believing that some infections have been missed and others wrongly diagnosed at the time of the surveys. The data indicate that the quartan rate probably fluctuates in the same manner as that of the other malaria infections. The persistence of *P. malariæ* blood infections during months of low fever incidence has been verified. The geographical distribution of the *P. malariæ* infections reveals the presence of definite foci which consistently produce new cases each year. There is no obvious reason why the rate should continue so low, i.e., why there is no epidemic increase in quartan comparable to that of the other malaria fevers.

The Isolation and Cultivation of Herpetomonas Muscæ Domesticæ (R. W. Glaser).—A method is described whereby a flagellate protozoan (*Herpetomonas muscæ domesticæ*) parasitic in the alimentary tract of adult house-flies can be freed from the intestinal flora and grown indefinitely in pure culture. Previous attempts at cultivating many protozoa parasitic in the alimentary tract of insects have usually failed due to the inhibiting effect of the bacterial flora which is difficult to separate from the protozoa. A detailed description is given of the process for the purification and isolation of the flagellate, and a detailed study of the growth characters and of the living micro-organism is presented and by a study of fixed and stained preparations the morphology of the cultural forms is described and compared with the forms found in flies. It has been proved that the flagellate cultivated is actually *H. muscæ domesticæ*, and additional proof is furnished that the genus *Herpetomonas* is closely related to the genus *Leishmania*.

The Common Picture of Sprue, Pernicious Anæmia, and Combined Degeneration (A. C. Reed and H. A. Wycoff).—The purpose of the authors has been to show that a common clinical entity is embraced by the accepted diagnosis of tropical sprue, pernicious anæmia, and subacute combined degeneration of the spinal cord. There exists a common toxin manifesting different intensities in each disease, which attacks the blood, the gastro-intestinal tract and the spinal cord. It is also suggested that the toxin is more likely a protein or type toxin than a unit chemical substance, and that its place of origin is in the digestive canal. There has been no evidence that either Protozoa or Metazoa is necessary for production of such a toxin. Either or both might well be an associated cause or secondary invaders obtaining foothold because of the damage already done to the intestine. Cases are reported to illustrate the points at issue.

Original Communication.

THE CAUTERIZATION OF ADHESIONS IN ARTIFICIAL PNEUMOTHORAX TREATMENT OF PULMONARY TUBERCULOSIS. TECHNIQUE AND INDICATIONS, TOGETHER WITH A SURVEY OF RESULTS OBTAINED.[1]

By Professor H. C. JACOBAEUS.

FOR about fifteen years I have occupied myself with endoscopy of the serous cavities, peritoneum and pleura. At first, I was interested only in the diagnostic advantages which could be gained by such a method. In a case of ascites, after tapping and replacing the fluid by air I could by endoscopy get a clear view of the abdominal organs. There was thus no difficulty in diagnosing liver cirrhosis, Pick's disease, carcinoma and tuberculosis of the peritoneum, &c.

Without doubt, the predominant value of endoscopy centres around the examination of the pleural cavities, the so-called thoracoscopy. With regard to the chest cavity we have, as we know, nothing corresponding to exploratory laparotomy. Further, thoracoscopy is so simple a method that it can be performed without inconvenience in every exudative pleurisy which is available to a thoracocentesis. The ocular examination of the pleural surfaces is in most cases relatively complete. In cases of so-called idiopathic pleurisy I have also succeeded in finding distinct tubercles in most of them. For the differential diagnosis of tumours and pleurisy of other origin, thoracoscopy is likewise of no small value. After some practice it is at least possible, with some certainty, to differentiate between tumour metastases and tuberculous changes. In doubtful cases, one can by test excision, under guidance of the thoracoscopy, decide the nature of the pleurisy in the special case. Even solid intrathoracic tumours can be observed by thoracoscopy, and their relations to neighbouring structures, lung, thoracic wall, &c., be determined much more clearly than by any other method. By this an evident practical advantage for an intended operation is gained.

The second and, from a practical point of view, the most important field for the use of thoracoscopy comprises those surgical operations which can be performed directly under guidance of this method. By thoracoscopy in the pneumothorax treatment of lung tuberculosis an especially fine picture of string-like adhesions between lung and thoracic wall is obtained. This caused me to try to work out a method under the guidance of the thoracoscope to remove such adhesions as impede the treatment. It is a well-known experience that a single string-shaped adhesion, which attached the lung to the thoracic wall and thereby prevents collapse of a cavity, can cause the failure of the whole treatment in artificial pneumothorax. A paper by Gravesen, from Professor Saugman's sanatorium, contains the following tables which prove the injurious results of these adhesions:—

(1) Cases with complete pneumothorax without adhesions (3 to 13 years after discharge).

Able to work	23	(62·1 per cent.)
Not able to work	1	(2·75 per cent.)
Died from tuberculosis	11	(29·65 per cent.)
Died from other causes	1	(2·75 per cent.)
Unknown	1	(2·75 per cent.)
	37	

(2) Cases with complete pneumothorax, but with localized, extended adhesions.

Able to work	14	(33⅓ per cent.)
Died from tuberculosis	28	(66⅔ per cent.)
	42	

(3) Cases with incomplete pneumothorax with larger or smaller extended adhesions.

Able to work	5	(11·1 per cent.)
Died from tuberculosis	39	(86·7 per cent.)
Died from other causes	1	(2·2 per cent.)
	45	

The injurious influence of the adhesions is plainly demonstrated by these tables, which also give one an impression of their frequency. I cannot here enter into the different methods attempted by others to remove such adhesions, I can only say that none of them has attained practical importance.

As it is rather easy to observe the above adhesions by thoracoscopy, the idea occurred to cauterize them by introducing a galvanocautery through another opening, under the guidance of the thoracoscope. My first attempts were made in 1913, and since then I have performed operations on altogether 170 cases, of which only 150 will be more closely dealt with here, the remainder having only recently been operated upon.

The method has also been adopted in most countries in Europe, in Germany by Unverricht, Gehrcke and others in Denmark by Gravesen, Kristofferson and others, in Norway by Holmboe, in France by Hervé and others, in Spain by Sayé, in Switzerland by Pignet, Giraud and Maurer, in U.S.A. by Singer, &c.

TECHNIQUE.

The preparations for the operation need not be very extensive, I do not consider it necessary to give the patient morphine before the operation. If he is very anxious I find it better to give him bromide, luminal, or similar remedies. It is of great importance to be sure that the electrical apparatus is in perfect working order.

Immediately before the operation I am accustomed, after the method of Saugman, to make a fluoroscopic examination and draw the points of attachments of the adhesions and their extensions on the patient's chest. This makes a very good guide when choosing the place for introducing the thoracoscope, it being always most advisable to have the light as near the field of operation as possible.

[1] From the Medical Service II of the Serafimerlasarett, Stockholm, Sweden (Professor H. C. Jacobaeus, Director).

The patient is put on his healthy side with a big, hard roll-pad under the chest as near the arm as possible (fig. 1). He has a smaller pillow under his head. The idea of placing him thus is to get the pneumothorax half of the chest as convex as possible. It is also advisable to let the patient's arm on the operated side lie upward and forward, so that the scapula is pulled upward and outward. The chest wall gets thinner, the interspaces are more easily felt, and the local anæsthetic can be given with more confidence and the thoracoscope can be introduced higher up on the chest wall without difficulty.

At the operation proper I first introduce the trocar for the thoracoscope after a careful local anæsthesia, generally one to three interspaces below the level where the adhesions are marked by means of the fluoroscope. This is, of course, not possible if the adhesions are localized to the apex, but one has to try to find an interspace as high up in the interscapular area as possible. The higher up on the

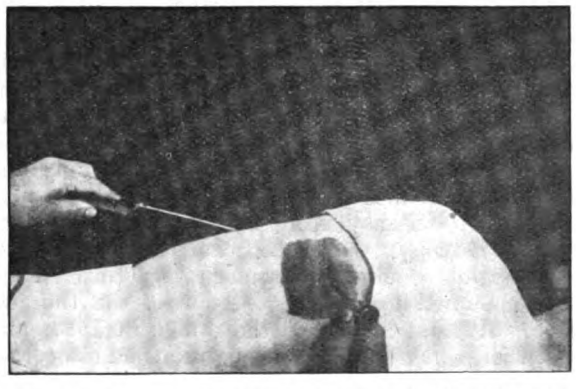


Fig. 1.—The position of the patient—on his healthy side—at the operation. The seat of insertion of the thoracoscope on the back and the point of insertion of the galvano-cautery and its direction of application in the case of highly localized adhesions.

chest wall one gets, the thicker the muscles are, and the more difficult it is to make the anæsthesia quite effective.

The thoracoscopy, which is first performed, aims to give as complete an orientation of the conditions in the pleural cavity as possible. If it is a matter of single string-shaped adhesions, then it is rather easy. In introducing the thoracoscope rather far back near the spine, before the thicker back musculature begins, one gets the longitudinal direction of the lung at right angles to the thoracoscope. In this way it is possible to get a survey of the lung in its longitudinal direction. As the adhesions generally extend from the lung to the chest wall at a more or less wide angle, it is evident that with this direction of the thoracoscope and the field of vision it will be easy enough to find and localize the adhesions in question.

If the adhesions are membrane-like, the difficulties are greater and no rule can be established. The same is the case if the lung is broadly fixed to the anterior or posterior chest wall and also with narrow strings in different directions. Only experience can solve the difficulties in such cases. The other stage of the operation, the cauterization itself, then begins. For insertion of the galvano-cautery I have employed of late a trocar of the same diameter as that through which the thoracoscope is introduced. One advantage of this is the production of a space between the trocar and the cautery enabling the respiratory air to pass to and fro. The smoke produced through the burning process is thereby automatically eliminated. The second advantage is that one is able to introduce the thoracoscope through either of the trocars. This is of no small consequence in the case of several adhesions being localized to different parts of the pleural cavity. In some cases it may be easier to see and reach the adhesions with the thoracoscope introduced from the front, in other cases contrariwise. When operating, therefore, I insert one trocar from the back and a second one from the front. The level at which the adhesions are situated determine whether the trocars should be inserted high up or low down on the chest.

The platinum needle has, during the past year, been slightly altered in a way that has proved of great practicability, in that the point has been made in the shape of a hook by which the adhesions can be easily caught and prevented from slipping off during the burning operation.

The galvano-cautery is carefully introduced in the direction where the adhesion is calculated to be situated. With some experience this is rather easy and I have many times introduced the cauterizer directly on the adhesion which I desired to burn off. If this does not immediately succeed, the adhesion has to be found with the thoracoscope in the thoracic cavity which, to begin with, may cause certain difficulties. After this, the platinum point has to be placed on the adhesion at the spot where it has to be cauterized. As regards a general rule, with string-shaped adhesions, I perform the cauterization where the adhesion is most narrow. If a cavity is visible on the X-ray film, immediately below where the adhesion is fixed to the lung, the cauterization should be made as close to the chest wall as possible. Technically this is slightly more difficult, but it causes the patient considerably more pain. In these cases the patient has really a sensation of a burning pain which extends diffusely throughout the whole half of the chest. Where it is a question of apex adhesions the pains radiate to the arm. If the cauterization is performed at a little distance (2 to 3 cm.) from the chest wall, the patient has scarcely any sensation of the cauterization, but has mostly a disagreeable feeling of pulling at the adhesion caused by the pressure of the galvano-cautery.

At the cauterization itself one has to decide the intensity of the glow of the galvano-cautery. This is of importance because of the possibility of hæmorrhage. After switching on the current, it ought to take five to ten seconds before the platinum needle becomes aglow, and then only a red glow. A white heat is absolutely dangerous.

The cauterization ought to proceed very slowly. In slightly pressing the galvano-cautery against the adhesion one feels how fibre after fibre is loosening. Then, bit by bit the adhesion can be burnt off, until at last it is completely severed, when the lung collapses by its own weight and usually an interval of several centimetres appears between the two burnt off stumps of the adhesions.

As above mentioned, the immediate danger of cauterization is hæmorrhage. The danger of a serious hæmorrhage arises if, in the cauterization, one penetrates the lung and there cuts into an artery.

I have only once in my experience had a hæmorrhage of any consequence. In this case there was quite a narrow thread-like adhesion. The cauterization went very easily and quickly, in a fractional part of a minute, but afterwards the parietal stump of the adhesion dripped blood rather rapidly. In all, the hæmorrhage might be estimated at the most to have been about 200 c.c. Other authors, such as Saugman and Skärgard, have at times had lesser hæmorrhages, which were considered to be caused by too strong a glow, at least by the latter operator.

Only once in all the operations known to me (thus far in more than 400 cases) has a fatal hæmorrhage ensued. In one case, where the operation, performed by Dahlstedt, proceeded quickly, a severe hæmorrhage suddenly set in. The blood spurted into the thoracic cavity. The prism of the thoracoscope became constantly splashed, and it was therefore impossible, under its guidance, to get at the bleeding point with the galvano-cautery, in order to stop the bleeding by a new cauterization. The bleeding became so severe that the patient lost consciousness for a moment. In another case, where the operation was performed by Skärgard, a similar arterial bleeding arose from the lung. Here the operator succeeded in stopping the bleeding by continuing to burn the bleeding part proximally. I myself have stopped quite small hæmorrhages by holding the galvano-cautery close to the bleeding place. Should a large arterial bleeding arise I think it best to get as high a pressure as possible in the pleural cavity in question. The best method to this end should be to fill it up with saline solution, which ought to stop the bleeding.

I should like to state, as my conception of the cause of the bleeding and its prevention, that:—

(1) The more severe hæmorrhages probably arise principally from cauterization of the lung itself.

(2) They can most surely be prevented by using a weak glow and by burning as slowly as possible.

In a previous paper I have, from a practical point of view, classified the adhesions into three different groups: (1) apex; (2) lateral; and (3) diaphragmatic. The limit between at least the first two classes is rather vague, and I have, therefore, fixed the second rib as the line between them.

The most common ones are of group 2, the lateral adhesions. A part of them borders on group 1, where we find the largest and thickest adhesions below the second rib and some smaller string-shaped ones higher up in the cupola itself. Or we find membrane-like adhesions, which continue toward the apex above the second rib. The reason why I have separated an upper group is because of the more difficult technique which is required for the apex adhesions. The technique of these cauterizations has for its object to introduce the thoracoscope as high up as possible in the back, after the scapula has been pushed upward and forward.

The difficulty in cauterizing these adhesions lies in the following circumstances. Most cavities exist in the apex of the lung, and these are fastened to the cupola itself by short adhesions. The movability of the lung in respiration is rather small here, and from this it follows that these adhesions during life are exposed to relatively little tension and are therefore short and consequently there is a risk of burning the lung. At all events, it is necessary to burn as close to the chest wall as possible, which often causes this operation to be rather painful.

The lateral adhesions from the area below the second rib to the diaphragm are the most numerous. They are mostly quite easy to get at. Diaphragmatic adhesions also deserve closer consideration. In all my cases of this kind it has happened that the lung above has been attached to the chest wall to such a high degree that it has not been possible to undertake any cauterization there. Besides, there have existed from one to several narrow, string-shaped adhesions to the diaphragm. By burning them off it is possible to get the lung pushed up, and thereby also obtain a more complete collapse of the lung. From a technical point of view, the cauterization presents the difficulty that the patient must hold his breath during the cauterization, because otherwise the adhesions are in constant movement. If the cauterization succeeds in a single burning there is no difficulty, but if, as is generally the case, the galvano-cautery has to be applied several times on this swinging band, it can be very troublesome technically to remove such adhesions. An advantage is that the burning of such adhesions is completely painless. Another question is the practical use of cauterizing such adhesions. In my experience it is only in exceptional cases—only in one of my four cases—that it is of any real benefit to do so.

Indications.

It is necessary before each cauterization to have an X-ray photograph of the collapsed lung with its adhesions. The first question that arises is, then, how much can be judged from the X-ray picture about the prospects of a successful operation? In cases where only one or two isolated, string-shaped, long adhesions are to be found the indications are easy, and one can assume at once that from a technical point of view it is possible and very likely easy to cauterize the adhesions.

It is more difficult to select those cases in which the X-ray apparently shows too thick adhesions, or in which relations are perfectly indistinct and one does not know the nature and extent of the ad-

hesions. In the latter case one has to rely on the thoracoscope.

I can state that in the majority of the cauterizations there have always been found more adhesions than were visible on the X-ray picture. This is generally of less importance, because the unobserved adhesions are, as a rule, so thin that they do not present any serious obstacle to cauterization. Experience shows, however, that cauterization in most cases is more difficult than can be expected from the X-ray picture.

From both the literature and private information, I have become familiar with cases in which attempted thoracotomy has revealed the adhesions to be much thicker than was originally supposed. In these cases the operation was consequently more difficult and involved more extensive interference than had been anticipated.

The other method to determine the possibility of operation is thoracoscopy. This will, according to my opinion, become more and more important in deciding the possibility of operation in the more serious cases, not only with regard to cauterization but also other surgical methods.

By thoracoscopy one gets a perfectly accurate picture of narrow, string-shaped adhesions, up to the thickness of a small finger. The difficulties appear in the case of membrane-like adhesions and those attached to the surface.

In perhaps the majority of cases one can see the compressed lung in its proper colour, greyish-red, with distinct vessels in its longitudinal direction. The tissue is loose and spongy when pressed with the galvano-cautery. Often the adhesion runs like a membrane along the ribs. It vibrates when the patient coughs or is shaken. In these cases there is also a transparent bluish colour. These adhesions are the most favourable ones for cauterization, which may be done easily, rapidly, and without pain worth mentioning. The danger of hæmorrhage can surely not be great.

I have burnt off adhesions with rather large, even varicose, vessels without any bleeding whatever.

The string-shaped, stretched adhesions, thinner than a pencil may well contain lung tissue and perhaps also offshoots from cavities, but they are still, in my opinion, not dangerous to burn off, just as in the case of hæmorrhages one has to attach a certain importance to the immediate, marked shrinkage of the adhesion after cauterization in preventing tuberculous infection of the pleura.

While working with thoracoscopy, one can see the adhesion stumps shrink to half of their original size or more within a few minutes. Without doubt, offshoots from cavities which exist there must be compressed and obliterated. This sounds bold and hypothetical, but I believe that it is so. If these adhesions are microscopically examined one finds not infrequently offshoots from cavities filled with necrotic tissue. To date, several hundred adhesions have been burnt off, and in only a very few cases has a cavity been opened, with resulting mixed infection in the pleura. The long and severe pleurisies after the operation seemed to be caused by the opening of tuberculosis foci by the cauterization, and then the infection spreads to the pleural cavity. I have not infrequently had string-shaped adhesions, which at X-ray examination and on thoracoscopy, have been technically easy and possible to burn off, but in which I have, nevertheless, refrained from doing, because it was necessary to consider the clinical effect obtainable by the removal of the adhesions in question. According to Saugman's and Gravesen's statistics, the difference between the prognosis of those cases with and those without adhesions is so great that practically all string-shaped adhesions, which are technically possible of removal, provide an indication for cauterization. I believe that as long as one cannot, as is now the case, decide upon the risks of the operation, one ought to have some more definite indications. If, for instance, the case is one of a patient whose general condition is excellent, who has no sputum and whose compressed lung shows no sign of cavity, I have not considered the indications sufficient for operation.

The unlimited possibilities of variation are, however, such that this rule cannot be absolute. If a case has a cavity in the lung, and is without tubercle bacilli or sputum, and has the lung expanded by adhesions, and is technically operable, then I consider it one for cauterization. In such a case sputum or bacilli usually appear again sooner or later.

In some cases, as Holmboe and myself have pointed out, there is no sputum, but after every introduction of gas the patient suffers an intense irritating cough for several days, which bothers him a great deal and prevents sleep. In these the adhesions are, as a rule, very narrow and sometimes they do not even appear on the X-ray photograph I have not seen such symptoms in cases with extensive adhesions. I consider cases with such symptoms as full indications for cauterization, so much the more as these adhesions for the most part are very easy to remove.

Finally, the presence of an exudate influences the indications for operation. According to my experience an existing pleurisy always becomes worse after a cauterization. I have in two cases seen a serious empyema set in as a nearly direct consequence of this. With a pleuritic exudate present, it is also, as already mentioned, difficult to determine the operative possibilities. The pleural surfaces are covered with fibrinous membrane and granulation tissue. The difference between lung and adhesion is not apparent; everything appears on a greyish background. In the cauterization itself one has to proceed with great caution, but it is not always as difficult as imagined. The adhesions appear very thick, but their outer layer is mostly loose granulated tissue, which is easy to penetrate. During pleurisy, one's net impression is that no operation should be performed unless there are good prospects of a decidedly favourable effect.

Tuberculosis of the larynx is no contra-indicati n

Tuberculosis in the other lung permits of cauterization only if it is necessary to continue the patient's pneumothorax. In cases of tuberculosis of other organs the same rule holds.

A summary of the indications for cauterization of adhesions will, therefore, be as follows:—

(1) String-shaped adhesions up to the thickness of a little finger, found by X-ray examination, can always be burnt off, and this operation can, as a matter of fact, be done without great risk.

(2) Membrane-shaped adhesions are similarly suitable for cauterization. The possibility of operating upon them is best decided by thoracoscopy.

(3) With regard to surface adhesions, there is need for great precaution, and one should burn off only the granulation tissue which attaches the lung to the chest wall. By cauterizing the lung itself there is the risk of hæmorrhages as well as opening of tuberculosis foci and cavities, with a consequent infection of the pleura.

Critical Survey of Operations thus far Performed.

In a critical survey of 150 cases, I will first consider those complications which followed operation immediately or ultimately. To begin with, we must refer to the skin emphysema of greater or less degree which appears at the points of puncture of the chest wall. This complication can cause trouble for two or three days, after which it disappears and is of no further consequence.

Of greater importance, however, are the pleuritic exudates which may follow operation. In the following table I have set down the various results which occurred in my cases:—

1.—Cases without exudate or with slight exudate ...	111
2.—Cases with long-lasting exudate and fever ...	21
3.—Cases with long-lasting exudate with empyema ...	14
4.—Cases with exudate, first appearing one to three three months after operation	4
	150

The first group is made up of cases the clinical course of which proceeded most favourably. After a few days' pyrexia the temperature returned to what it was before the operation. In cases with effusion this has rarely reached above the diaphragm and has generally been absorbed in one to two weeks.

In my opinion, therefore, these effusions are merely reactionary results of the thermic and mechanical interference at the operation, and do not in any way affect the clinical results.

The second group is comprised of cases where the effusion has been quantitatively much greater, filling up at least half of the pleural sac and remaining for several weeks or months. On examination of the exudate tubercle bacilli have been found on inoculation of animals. In my opinion tuberculous foci have become opened in the process of cauterization, the pleura thereby being infected. The temperature in these cases has been high and the general condition adversely affected for a long time. A good result, even if belated, however, has generally been obtained.

The third group is the most important, because of complications, it involves the most serious one. Two types may be distinguished. One of them is characterized by symptoms of acute pleurisy of a severe kind setting in soon after the operation with sharp pains in the side, dyspnœa, high temperature and the general condition much affected. Tubercle bacilli are frequently found in direct preparations. Symptoms supervened pointing to "valvular" pneumothorax from the breaking of a cavity and before long there were signs of pyo-pneumothorax. The author has had two such cases where death followed very soon after the operation. In a third case the progress was most favourable after the operation, the lung with its cavity becoming completely collapsed; three weeks after the operation, however, the cavity broke with a subsequent " valvular " pneumothorax, pyo-pneumothorax and later death. One was not able to definitely establish here to what extent the cauterization was to be blamed for the result. Had the cavity been opened in conjunction with the operation, severe symptoms, such as described above, would probably have arisen immediately afterwards and not after such a long time. A thoracoscopy gave no information as regards the seat of the perforation, and autopsy being refused the origin of the empyema was never revealed. The second type is characterized by an initial serous pleurisy that gradually passes into an empyema. This has been the event in most of the cases, the prognosis then being more favourable, many of them having recovered.

The last group is of less interest. Four of them developed effusions one to three months after the operation. Pleuritic effusion occurring so commonly in the course of treatment by pneumothorax renders it is impossible to say whether the pleurisy in these cases was of spontaneous nature or developed as a result of the operation.

I will therefore pass on to the results obtained by the operation.

Number of cases	Technically successful cauterizations	Clinically successful results	Incomplete cauterizations
150 ...	121 ...	99 ...	29

On the whole these figures are similar to those already published in previous works, with an increase, however, of the good results. This is primarily due to a further knowledge as regards selection of suitable cases but also to some extent to an increased technical skill.

The group of technically successful cauterizations includes all cases where the adhesions have been removed to such an extent as to render the lung completely compressed. In the group of clinically successful cases I have collected those where after a shorter or longer time—one week to a month and sometimes even longer—the sputum has ceased and the temperature has become normal. We are only concerned here, however, with the immediate results after one or several years.

The last group (the incompletely cauterized adhesions) is comprised of those cases where, as implied by the heading, the lung has not been freed from its attachment to the chest wall to such an

extent as to permit of sufficient collapse. However well defined this group may be, it is not always easy to make a distinction between these cases and those technically successful. Border-land cases exist, where the lung has been freed for the most part, but where it might take quite a long time, sometimes several months, until a clinically good result may be demonstrated. In such cases one must bear in mind the possibility of healing taking place through Nature's own resources.

It is of great interest to study more closely the twenty-two cases where the operation was technically successful but clinically where no good results followed. In six of them a pleurisy was present before the operation, in two of which there was even a chronic empyema. The condition became aggravated, varying somewhat in the different cases but with the general state of health much lowered in all of them. The clinical result, therefore, was bad, although it is not so easy to say to what extent this was due to the operation. In some of the cases this had undoubtedly a deleterious effect.

Out of nine cases, in which the pleura before the operation had been normal, two developed acute empyema with alarming symptoms, death taking place in the short time of ten to twenty days. In the remaining cases there was first an ordinary serous pleurisy, that later, after a shorter or longer interval, became purulent.

In four cases no pleurisy developed, but the changes present in the other lung before the operation became aggravated. In another case a fatal tuberculous enteritis supervened. In a third case the patient suffered from severe diabetes; the operation was an extensive one and although some temporary improvement followed upon treatment with insulin, the patient gradually developed empyema and progressive tuberculosis.

In a final case with a poor general condition an extensive cauterization was undertaken with a technically good result. Some days later a severe attack of asthma set in, from which the patient had been suffering for several years. One was not able to utilize the results obtained by the operation and the patient died.

In cases incompletely cauterized no harm has generally resulted from the operation, this being interrupted in good time, as it was generally obvious at a fairly early stage that no success was to be attained. In not a few cases—perhaps half the number—has the operation been performed in strange places for the purpose of demonstrating the technique, and under these circumstances it was impossible already from the start to make the operation complete.

Two cases are deserving of great attention, inasmuch as they developed an adhesive pleurisy after the operation, necessitating interruption of the pneumothorax treatment after some time with a reverse effect to what had been desired.

It is of great interest to note the results with reference to the different kinds of adhesions according to the basis of classification already evolved. Out of 74 string-shaped adhesions in altoge technically successful cases there was a fa result in 64 and an unfavourable one in total figure for the membranous adhesion of which 23 were favourable and 4 unfav and finally for the surface adhesions—20 all—there were 13 favourable and 7 bad

From the point of view of the localizatior adhesions, in the thoracic cavity, on the othe they are distributed as follows. There are cases of diaphragmatic adhesions, in one which the result was satisfactory. It is prob very exceptional cases that these adhesions satisfactorily dealt with by operation.

Of the remaining groups the adhesions are localized to the apex in 33 cases and laterall ated in 113. It may be mentioned for comp that in the first 50 cases published the adh were apical in 5 cases, lateral in 42 anc phragmatic in 3 cases. It is clear from this in direction changes tend to occur.

Out of 33 cases with apical adhesions suff collapse was obtained in 30 with good resul 19. Of the remaining 113 cases with latera hesions technically successful cauterizations performed in 89, in only 7 of which the results inferior.

To sum up the above results, it may be seen these are less favourable in the case of apical diaphragmatic adhesions where also the opera technique is very much more difficult. The results are undoubtedly obtained with the la adhesions, notwithstanding the fact that operat are more often undertaken here, technically possible of being completed.

As has already been repeatedly pointed the above results of the operation are imme and do not represent any remote results. Thr the operation the patient has been temporarily from sputum and bacilli. The subsequent pro has nothing to do with the operation and is su to the same factors that have a bearing upon case undergoing treatment by pneumothorax. benefit of the operation in that case is to be in a better prognosis, in that recovery whicl cording to Gravesen's figures, takes place in 1 cent. to 33 per cent. of cases with adhesions, to 70·2 per cent., confirmed after several ye

Among authors Gravesen is the only one gives in tabular form his material one to six after the operation, and has arrived at the fol result. I have unfortunately been unable to any after-examinations of cases in my ext material, the patients having been operated in so many distant places in different cor A rough estimate, however, gives a much percentage of recoveries, rather below than 50 per cent., primarily due to a progressive culous infection in the other lung or some part of the body.

Able to work	17	(65 per cen
Ill with tuberculosis ...	1	(4 per cen
Died from tuberculosis ...	8	(31 per cer
Total ...	26	

Although Gravesen's figures are too small to justify any general conclusions to be drawn from them, they are nevertheless of the greatest interest. The results are in my opinion better than could be expected. They approach as near as possible the statistics given by the same author concerning uncomplicated pneumothorax, where the percentage of those capable of working was 70 per cent. These figures are also of interest from this point of view, that the cases with adhesions are to be considered as a more advanced and severe type of pulmonary tuberculosis as compared with that in uncomplicated cases of pneumothorax.

Extracts from the Casuistic.

Case 132, Miss B.B., born March 3, 1895.—No heredity for tuberculosis. In December, 1920, left-sided pneumonia, after that weak for a long time; only in July, 1921, restored to health. In August, 1923, consulted for the lungs, because she had coughed the whole time since 1921, and now lung tuberculosis was proved. Pneumothorax established January 31, 1924. May 17, 1924, cauterization of some adhesions on the upper part of the lung: only partial success. Three weeks after the cauterization rising temperature and exudate, which had diminished since November 24, simultaneously got worse and again subfebrile temperature. Lately better and afebrile, except at premenstrual periods. Sputa, which before November, 1924, were absent, have since then been about 10 to 15 c.c. Tubercle bacilli always present.

Admitted February 16, 1925. General condition good. X-ray examination February 17, 1925. Left-sided pneumothorax with good compression of the lower part of the lung. In the upper part a cavity of quite the size of a goose's egg. The upper part of the lung is kept expanded by a broad, outward, well-defined adhesion opposite the clavicle and the first rib. In sinus an exudate which in a sitting position reaches to about the level of the diaphragm cupola. (Fig. 2.)

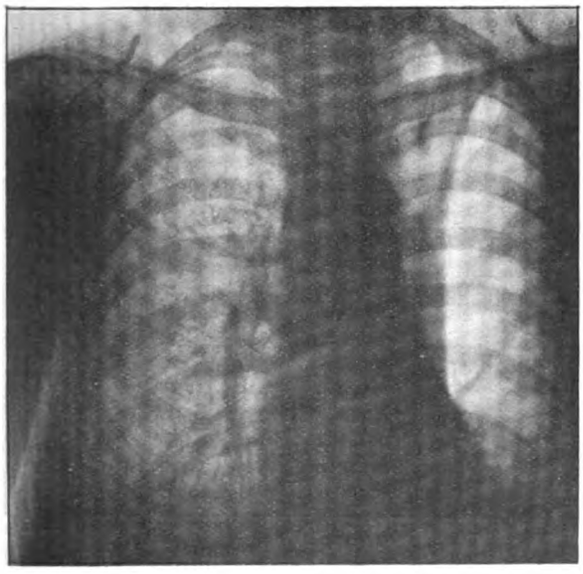


Fig. 2.—Case 132. Cavity in the upper part of the lung, the size of a goose egg, which is kept expanded by a short adhesion opposite the clavicle and the first rib. The dark defined shadow in the middle of the cavity represents an adhesion, which is attached to the front side of thorax in a frontal direction.

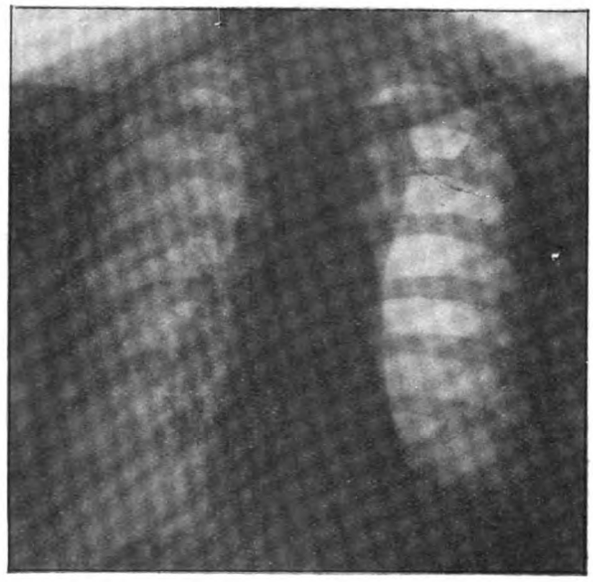


Fig. 3.—The same case after the first operation. A small adhesion in the middle of the apex area still remains.

February 23, 1925.—First operation.—On thoracoscopy pleura parietalis normal, pleura pulmonalis greatly thickened, grey-white above the upper lobe. Laterally upwards a transverse adhesion with free edge forwards. Posteriorly it continues upwards, so that the apex cannot be seen. There is, moreover, visible a string-like adhesion of the thickness of an ordinary string and another one thicker than the little finger. The thick adhesion was first cauterized away from the free edge. It proved to be a surface adhesion which extended obliquely backwards and upwards over the apex of the lung. It was cauterized quite close to the pleura parietalis, across at least one and a half interstices. The furthest part could not be removed on account of the vaulting of the lung. The lung has collapsed several cm. After that the two above-mentioned adhesions were easily cauterized, and also two string-like adhesions in front. Remarkably slight pains during the operation (25 minutes). Progress after operation favourable.

X-ray examination March 7, 1925.—The previously described ribbon-like adhesion laterally has disappeared and the apex area seems more collapsed than before. There is, however, on the lung a small dentiform curve, corresponding to the place of the old adhesion. Over the apex area remains a string-like adhesion. (Fig. 3.)

March 13, 1925.—Second operation.—On thoracoscopy the lung seems considerably better collapsed than before. The extensive wound upwards is

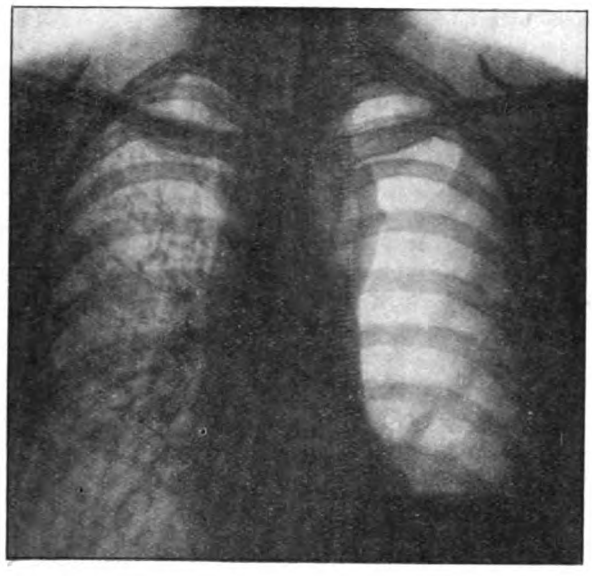


FIG. 4.—The same case some days after the second operation, when the lung is free upwards. Remarkable is the gradual thickening of the cavity wall after each operation.

covered by a thin layer of grey-white granulation tissue. Uppermost in the pleural cupola itself there remains a broad flap of the adhesion, but its thickness cannot be determined. The burning was rather easy, although the adhesion was fairly fibrous. Further down on the lung somewhat anteriorly there is a fibrin-covered, rind-like spot, about the size of a shilling, surrounded by subserous hæmorrhages. No pain, no bleeding. Progress after operation exceedingly favourable.

X-ray examination March 24, 1925.—The adhesion, stretching towards the apex area, which was described on the previous radiogram, is now cauterised, the lung further collapsed, so that the upper part of the cavity lies at the lower edge of the sternoclavicular joint. The cavity measures 1 cm. in width and 5·5 cm. in height. (Fig. 4.)

March 28, 1925.—The patient could leave the hospital for policlinical treatment. During this time complete collapse of the lung was obtained. No sputa.

Epicrisis.

The case gives a typical picture of a certain kind of apex-adhesion, of which the author has treated eight. The technique is difficult and the operation risky. This case also proves how difficult it is during the process of operation to judge how far the cauterization has progressed. The very favourable clinical result, without any disturbing influence due to the pleurisy getting worse, is in a high degree noteworthy.

Case 133, Mrs. I.M.L., aged 40. Husband died of pulmonary tuberculosis. Ten children, one treated in the surgical division for tuberculous knee. Quite well till 1913, when she developed fibrinous pleurisy, lasting for seven weeks. Similar condition 1917. This year tuberculosis in lung was diagnosed. Seven months at sanatorium. After that looked after herself at home, felt well and carried out her duties.

At the end of October, 1924, caught a chill, with raised temperature and cough, but improved somewhat during the following weeks. The last month marked emaciation and poor appetite. *Condition* November 29, 1924.—General condition bad. Ordinary frame of body. Superficial fat loose and reduced in amount. Muscles average.

On examination of the lungs one finds on the left side extensive and partly recent tuberculous changes with cavity formations, and on the right side older changes in the upper third. Nothing abnormal found in other organs.

X-ray examination January 8, 1925.—Left-sided pneumothorax. The lower lobe fairly well collapsed at the base. The apex seems to be drawn out towards the lateral posterior thoracic wall by a thin membranous adhesion. At the attachment of this adhesion to the lung there is a cavity, in size nearly as large as a walnut. The apex of the upper lobe is equally prevented from collapsing by several fairly thick strings of adhesions. A thick adhesion is seen in the first interspace, one behind the upper part of the first rib in front and one bundle of adhesions from the lung apex towards the supraclavicular fossa. (Fig. 5.)

January 24.—On thoracoscopy one found a membranous adhesion situated far backwards, its lower edge terminating just above the seat of insertion of the thoracoscopic needle and then continuing forwards. The upper border could not be seen. The cauterization was begun at the lower edge and was

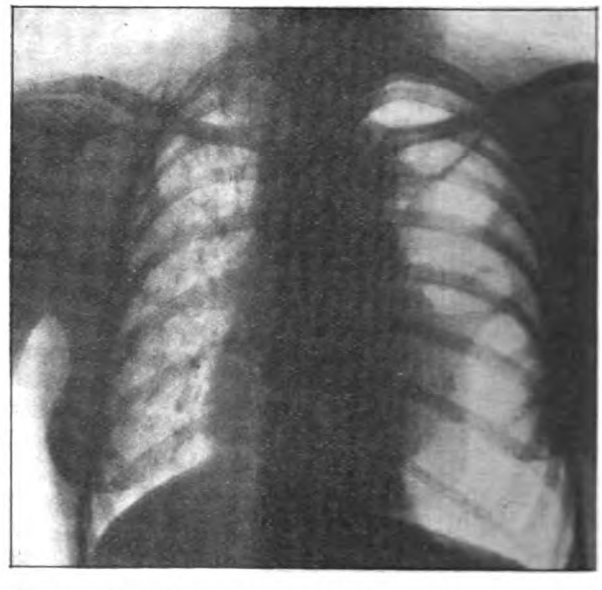


FIG. 5.—Case 133. A string-shaped adhesion obliquely upwards and outwards immediately below the clavicle and one less defined in a straight outward direction. Opposite the middle of the latter a lung-cavity as large as a walnut. In this case, however, there was only one continuous membranous adhesion, extending from the middle of the lung right up to the string-shaped adhesion seen uppermost.

continued for about 15 cm. straight upwards. This adhesion reached a thickness of, at an average, 1 cm.—in several places, however, extending to several centimetres—and was fairly fibrous in structure. Moderate pain. No bleeding.

X-ray examination January 28, 1925.—The left lung now well collapsed. No visible remains of adhesions. Exudate in the sinus. (Fig. 6.)

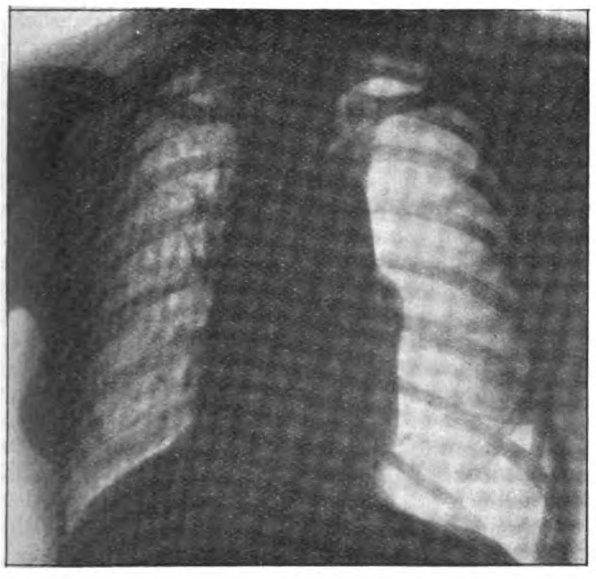


FIG. 6.—The appearance of the lung a few days after the cauterization.

X-ray examination February 17, 1925.—Left lung still well collapsed. No exudate since March 10; sputum: no tubercle bacilli. Discharged April 24 for further treatment at sanatorium.

Comments.

It is of interest to note in this case that, whereas numerous string-like and membrane-like adhesions were found laterally and in the apical region at the X-ray examination, only one large, membranous adhesion was found at the operation with numerous strengthening bands which had simulated free, string-like adhesions in the X-ray picture. The cauterization was comparatively easy and most effective in bringing about collapse of the lung.

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"SIMIAN JOURNALISM."

By Sir RONALD ROSS, K.C.B., K.C.M.G., F.R.S.

THE editor has asked me for my remarks on a book called "Microbe Hunters" which has recently been published in America and is said to be by one Paul de Kruif, whose name is entirely unknown to me. It is evidently meant to be a popular history of some discoveries in medical bacteriology and protozoology, that is, a book for the delectation of those who are ignorant of these subjects. An American once said to me, that of all low-class journalism American low-class journalism probably sinks the lowest. Abhorred by respectable Americans the writers make reputations out of vilifying people; and they escape the laws of men just as vermin escape the claws of animals—by their smallness, and, I hear, by the inadequacy of the American laws of libel. Usually, for obvious reasons, such writers persecute only well-known men such as millionaires, politicians and novelists. Unfortunately, it seems that they are now beginning to attack even humble scientists, who are routed out from their obscurity and paraded before an exceptionally ignorant public by men who write books on "Popular Science," without possessing sufficient knowledge of the subjects dealt with, and who do so, not in the interests of truth or of science, but chiefly to support their own existence.

The book under review is written in a "slashing style," but I think without due regard to facts and to the ordinary decencies of journalism. Its first chapters tell us tales of Leeuwenhoek, Spallanzani, Pasteur, Koch and others; most of whom are now dead and cannot reply for themselves. The style is personal, bumptious, and confident; but there are no citations of the literature concerned which would enable readers to verify the statements made. We are given verbatim accounts of conversations which the author could never have listened to and which must, therefore, have been invented out of his own imagination. Although these first chapters are generally laudatory they contain many personal references which their victims would certainly strongly resent if they had still been able to do so.

The later chapters, however, refer to several living persons, including myself, and do so in a manner which in this country would be looked upon as inexcusable. The ninth chapter deals with Bruce

and the tsetse-fly, and it is replete with statements which are misleading and contrary to facts. No credit whatever is given to Low, Christy, Castellani, and Nabarro; on the contrary, some of them are luridly slandered. The following statement is found with regard to the first Sleeping Sickness Commission: "The third member became disgusted with the ignorance and failures of his two colleagues and went off prospecting for rubber." Herewith the answer to this by the third member himself, viz., Dr. Cuthbert Christy:—

"*With regard to Chapter IX of Paul de Kruif's book 'Microbe Hunters,' I beg to emphatically state that it contains statements which are totally erroneous, misleading and some of them quite libellous. As an example I will quote paragraph* 2, *page* 264, *which reads, 'The third member (viz., myself) became disgusted with the ignorance and failures of his two colleagues and went off prospecting for rubber . . . .' This paragraph is absolutely untrue and libellous. It suffices to state that I have always given credit to Castellani for his discovery of the trypanosome as the ætiological agent of sleeping sickness—see, for instance, my letter to the* "Morning Post," *August* 22, 1923. *As regards my abandoning my colleagues, and going off prospecting for rubber, this is entirely libellous. I never abandoned my colleagues and, as a matter of fact, I did not get interested in rubber until* 1906, *which was three years after the labours of the First Sleeping Sickness Commission were completed.*"

Many of the statements found in the same chapter concerning Castellani are equally erroneous and some are pure inventions. It would appear from them that Castellani acquainted Colonel Bruce with his discovery of the trypanosome in the cerebrospinal fluid *en passant* without giving it any importance. Considering that Castellani made certain conditions before acquainting Bruce with his discovery, and that this has been publicly confirmed by Nabarro many times (*British Medical Journal*, October 6, 1917), how can it be said that he attached no importance to his findings and did not see the possible relationship between the trypanosome and sleeping sickness?

There cannot be any doubt that the fundamental discovery in the elucidation of the ætiology of sleeping sickness was Castellani's observations of trypanosomes in the spinal fluid of sleeping sickness patients, and one cannot see why there has been so much discussion on the matter. In the Royal Society's Report No. 8, in the paper by Colonel D. Bruce, Dr. D. Nabarro and E. D. W. Greig, received November 30, 1903, it is stated that "this most interesting discovery of Dr. Castellani's which was due to his introduction of the method of centrifuging the cerebrospinal fluid and his search for his streptococcus, has been of the utmost possible value to the present commission. It put them at once on the right track and led to the rapid and easy elucidation of the ætiology of this hitherto mysterious disease. Without a knowledge of his observation they might have worked for many months in the dark, and in truth, they might have even returned to England still ignorant as to the true cause of the disease." Surely this is very ample acknowledgment.

The tenth chapter is entitled "Ross v. Grassi: Malaria," and appears to me to have been probably written by Grassi himself with a few flaming touches by the author, or else to be compiled almost entirely from information given by the former to the latter, without investigation of the truth, and without citations of the pertinent literature. I am legally advised that many of the passages referring to me are libellous in British law. The author scarcely mentions Laveran, who discovered the malaria parasite in 1880, or King, who was the first to set forth the mosquito theory of malaria as early as 1883. To him, Manson, who added a vitally important item to that theory, was only "an eminent and mildly famous English doctor" who knew little about the subject. "What a pair of men those two were!" On page 282 the author says: "Manson knew so little about mosquitoes that he believed they could only suck blood once in their lives, and Ross talked vaguely about mosquitoes and gnats, not knowing that mosquitoes were gnats"; unfortunately, no one at the time knew better—a fact of which the author seems to be ignorant. He describes my father as "a ferocious-looking, border-fighting English general with belligerent side-whiskers." It appears that my colonel, in 1897, thought me an "insane upstart," that I ill-treated my patients, that I bungled, that I made discoveries which turned out to be no discoveries at all (just as every sound worker does), that I collected malarious Hindoos as a terrier collects rats, and that I loved them if they were full of malaria but detested them when they got better, that I was illogical, that I was anti-scientific, that I wrote shrieking poems, that I tried to stop a cholera epidemic and "did not stop it"—an experience which happens to many; that I wanted to throw my microscope out of the window. "How he fidgetted," says the author. I was a "mad poet." I was "lunatic Ross," I was "wild as the maddest of hatters." My work was done not by me but by one of my native assistants, whom the author calls *Mr.* Mahomed Bux. I fished for trout in India—where they do not exist. I "went wild," and then I "blew up." He sums me up by saying that I failed regarding human malaria. That when I wrote to Manson "the theory is proved," it was not proved, according to this learned author.

It is clear from the author's own writing that he knows little about the subject. On page 282, in describing the parasites of malaria he says that they "turn into little squads of spheres inside the red blood-cells" and then that the spheres "turned suddenly into crescent shapes"! The author evidently does not know what every student of tropical medicine has first to learn in the schools, and yet he presumes to teach others. On page 291, in a completely false statement about me, he confuses the malarial pigment of the parasites with the parasites themselves. If I were to expose and criticize every false or inaccurate statement in his 20 pages about

me I should have to write at equal length. He may have read parts of my "Memoirs" in order to vilify me, but he has not understood them in the least, and he does not mention the Memoirs by name. On the whole I think, from the internal evidence of his book, that he has obtained all that he does *not* know about me from my late ingenious friend, Professor Grassi, who started abusing me in the year 1900 and continued to do so steadily ever since that date until his death last year. I gather the same thing also from the rest of his tenth chapter, which praises that eminent man. He admits on page 298 that it was my work which helped "the learned, the expert, the indignant Battista Grassi to do those clean superb experiments that must end in wiping malaria from the earth. You might know that Giovanni Battista Grassi would be the man to do what Ronald Ross had not quite succeeded in bringing off." So Grassi has been saying all this time! Unfortunately, scarcely any of Grassi's statements (as those of his admirer) are true. Long ago Robert Koch said that "Grassi is a thief and a robber in scientific matters" (my "Memoirs," page 409), and Laveran described his doings as "Mesquins et malhonnêtes (*ibid.*, page 410). The "clean superb experiments" which the author of this book talks about were never made by Grassi. But I am not going to discuss this old matter here. The facts have been exactly stated, with references to all the pertinent literature, in my "Memoirs," and recently in a paper by me in *Science Progress*, No. 78, October, 1925, page 311. Grassi's alleged work on white ants and on eels was done chiefly by S. Calandruccio (see this journal July 1, 1901). The author's statement on page 299, that Grassi had done work on the mosquito theory of malaria before anybody had ever thought of the subject, is completely false. The statement in the author's next paragraph, that in the year 1898, "Grassi, knowing nothing of Ross, never having heard of Ross, went back to malaria again," is also completely false—Grassi mentions my work twice in the first page of the very first paper which he wrote on the subject, and in his next paper he admits having received my Report and one of Manson's articles and specimens from him, and this was before he and his colleagues made any additions at all to our knowledge of the subject. I have exposed this over and over again. The author's statement on page 303, that Grassi declared to the *Lincei* that "it is the anopheles mosquito that carries malaria if any mosquito carries malaria" is utterly apocryphal, as can at once be seen by consulting the original literature, which the author of this book has evidently not done. So also with nearly all of his other statements. The further adventures of Grassi, as related by Mr. Paul de Kruif, remind one of the equally surprising adventures of Sindbad the Sailor or of the late Baron Munchausen—but I really cannot take the trouble to expose the author's inventions in detail. There are also fundamental errors in such other parts of this silly book as I have had the patience to look through, but it is not necessary to mention them.

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COLOMBIA AND ITS DISEASES.[1]

SINCE the opening of the Panama Canal a few years ago more attention has been directed to the countries of Central America and the adjacent regions, including the Republic of Colombia, formerly known as New Granada, with its capital, Bogota, which occupies the north-western portion of the South American Continent and actually borders on the district of Panama. With an area about thrice that of France or Germany, Colombia has a population of about six million souls.

Lying as it does beneath the Equator, Colombia is, geographically considered, a tropical country, but owing to the configuration of its surface, ranging from the coastal regions and low-lying river basins

[1] "Geografía Médica y Patología de Colombia." Dr. Louis Cuervo Márquez. Bogota and New York: Camacho Roldam y Tamayo. 1915.

to the high mountainous regions of the Andes, it presents a great diversity of climate. Hence five zones have been described as characterizing this variety of climate, namely:

(1) The *tierra ardiente*, limited to a few regions such as the lower parts of the Magdalena River, where the stones are often so hot that they cannot be touched; (2) the *tierra caliente*, the hot region up to an elevation of about 3,000 feet, comprising the plains of the north, west and south-east, and the great river valleys of the Magdalena, Nieta and Putumayo; (3) the *tierra templada*, or temperate zone, at elevations of from 3,000 to 6,500 feet; (4) the *tierra fria*, or cold region, from an elevation of 6,500 to 10,000 feet; and (5) the higher plateaux and mountain slopes. The bulk of the population are to be found in the temperate and cold regions, especially in and around the capital, Bogota, at an altitude of over 5,000 feet.

The tropical low-lying lands, which are unsuitable for the permanent residence of white races, are characterized by the presence of mosquito-transmitted diseases, yellow fever, malaria and filariasis, and in the malarial districts, blackwater fever. Uncinariasis, known also under the names of tun-tun, imbombera, jipatera and tropical anæmia, is the most extensive endemic disease in Colombia. Occurring in the same regions, but much less frequently encountered, is trichocephalosis, infestation with *Trichocephalus trichurus*. Dysentery, both amœbic and bacterial, occurs, and similar symptoms result from infections with the hæmatozoa of paludism, *Balantidium coli*, Trichomonas, Leishmanias, and nematode worms. Spirochætal or recurrent fever, due to *Spirochæti duttoni*, *S. obermeieri*, and other species is encountered in many localities in Colombia. *Ornithodorus moubata and O. turicata* appear to be the transmitting ticks. Leprosy is widely spread throughout the country, occurring at all altitudes and at all temperatures and meteorological conditions. Also widely generalized through Colombia is hypertrophy of the thyroid gland, known as coto, which may exist as the sole glandular manifestation or may co-exist with cretinism.

Although tuberculosis is world-wide in its distribution, and consequently Colombia does not escape its ravages, nevertheless pulmonary tuberculosis has been distinctly rare in Bogota for the last thirty years, and the same may be said of tuberculous meningitis and generalized tuberculosis. No doubt the altitude of Bogota exercises a favourable influence.

Of the eruptive fevers, smallpox presents itself in widespread epidemics, as does measles, with or without whooping cough and scarlet fever, whilst dengue is occasionally encountered in limited areas. Beri-beri is also occasionally met with, and as it does not occur in epidemics, presents great difficulties in diagnosis, having to be differentiated from alcoholic neuritis, paludic cachexia, lumbar myelitis, locomotor ataxia, pernicious anæmia, uncinariasis, interstitial nephritis, and chica intoxication.

A dermatosis practically limited to tropical America, known as carate or pinta, is extremely common in Colombia, where about four per cent. of the population is said to be affected. A patient suffering from this disease is known as a "caratejo." The condition is an inoculable contagious dermatosis produced by the several varieties of the aspergilli and probably other species of fungi, and transmitted by a similium and other insects. Clinically it is characterized by the presence of patches, usually symmetrical, which vary in colour, there being black, blue, violet, red, yellow and white varieties.

The presence of the cutaneous lesion usually produces no repercussion on the general health of the patient, though very exceptionally they are accompanied by fever and all the symptoms of a general infection. The topical application of mercurials to the affected patches constitutes the most effective treatment.

An alcoholic liquid prepared by the fermentation of maize, and known as chica, is a popular beverage throughout the country, and it has been calculated that 250,000 litres of chico are consumed daily in Colombia. Intoxication by chica, accordingly, is extremely common. Insolation, mountain sickness and snake-poisoning are all frequently observed, as would naturally be expected in a country with the geographical position and topographical characters of Colombia.

F. E. T.

Annotations.

The Causation of Malignant Neoplasms (J. Loudon, J. M. McCormack, and N. J. Howard, *Medical Journal and Record*, May 5, 1926).—A similar pleomorphic micro-organism from every type of malignant growth with which the authors have worked has been isolated, including human carcinoma, mouse carcinoma, rat carcinoma, human sarcoma, rat sarcoma (Jensen), and Rous chicken sarcoma No. 1. The life-cycle of this pleomorphic micro-organism consists of three microscopically visible stages and of an ultramicroscopic or filtrable phase. Each of these microscopically visible stages can be grown in pure cultures and subcultures and at will, changed into pure cultures of another stage in its life-cycle. Injections of this micro-organism into animals, with a trace of infusorial earth, produces malignant metastasizing growths. The micro-organism can again be recovered in pure culture from these primary and secondary animal growths. The pleomorphic organism described by Young and Stearn, and by Sturdivant and Stearn appears to be similar to the micro-organism here described. The micrococcus isolated by Nuzum, of Chicago, from carcinomatous tissues and the ultramicroscopic organism described by Gye and Barnard appear to be individual stages in the life-cycle of this micro-organism. The specific factor of Gye contains the living specific micro-organism described herein, though the organism has been attenuated by the chloroform treatment. Human carcinoma has been effectively treated by a serum antitoxin.

Chilomastix Gallinarum, Morphology, Division and Cultivation (W. C. Boeck, *American Journal of Hygiene*, May, 1926).—*Chilomastix gallinarum* occurs in the cæcum of turkeys and chickens. It is readily transferred from one bird to another by the ingestion of material containing the motile or encysted organisms. It possesses three anterior flagella, one cytostomal flagellum, a large cytostome, ventral in position, an anteriorly situated vesicular nucleus, four blepharoplasts and a centrosome. The cysts are similar in shape to those of *Chilomastix mesnili*, but as a rule slender and of smaller dimensions. Division of the motile flagellate is by binary fission. The nucleus passes through the several phases of mitosis. About twelve chromosomes are formed. The parent blepharoplasts divide to form new ones and the new flagella and cytostomal flagellum appear as new outgrowths. The plane of division is morphologically longitudinal. *C. gallinarum* was cultivated for a period of six months in association with *Pygolimax gregariniformis*, an amœba, also from the turkey. The culture media used were either (*a*) Locke solution, 8 parts and human serum 1 part, or (*b*) the L.E.S. medium previously described by Boeck (1924). The parasite, from cultures obtained from the turkey, was transferred to young chicks, either by feeding them with material from cultures or by injecting the material per rectum. *C. gallinarum* differs from the newly-created genus *Tetrachilomastix* (de Fonseca 1916, 1920) inasmuch as it does not possess four free anterior flagella. It differs but slightly from *C. mesnili* from man, but is better accommodated in the genus *Chilomastix* than in the genus *Tetrachilomastix*.

Biological Studies on the Life-Cycle in the Genus Strongyloides Grassi, 1879 (J. H. Sandground, *American Journal of Hygiene*, May, 1926).—A review has been made of the literature on the genus *Strongyloides* and apparently there is nothing known definitely about the underlying causes which determine the alternative modes of development that occur in a number of species of this parasite. The theories that were advanced by Leichtenstern and Darling to explain the phenomenon are found to be either insufficient or entirely inadmissible on further investigation. The belief that the direct mode of development is restricted to infections contracted in the temperate zones and that infections contracted in the tropics show only the indirect or heterogenic mode of development, which formed one of the main foundation-stones for Leichtenstern's hypothesis, is found to be untrue. The usual method of demonstrating the mode of development by the direct examination of small fæcal cultures is unreliable. The examination of cultures of larger amounts of material, using the Baermann isolation technique, reveals the fact that in a large proportion of infections, with various species of the parasite, both modes of development co-exist. It is further shown that by following infections over a considerable time the quantitative relationship between direct and indirect development is subject to constant changes. Infections of certain abnormal hosts lead to changes in the life-cycle, and the suggestion is made that direct development in certain species originally arose following the introduction of the more primitive heterogenic parasite into new species of hosts. The parasitic female of *Strongyloides* is at present held to be parthenogenetic; a cytological study of the gonads indicates that it is really hermaphrodite. This furnishes the basis for a theory that the direction of development is determined by the chromosomal constitution of the eggs, subsequent to fertilization, and that the sex of the rhabditiform generation is determined according to whether the eggs are fertilized by sperm bearing or not bearing a heterochromosome.

Current Literature.

INDIAN MEDICAL GAZETTE.
May, 1926.

Some Factors Affecting the Propagation of Hookworm Infections in the Asansol Mining Settlement, with Special Reference to the Part Played by Cockroaches in Mines (A. C. Chandler).—Surface infestation of the soil with hookworm larvæ is practically entirely stopped for about six months of the year, due to desiccation. In consequence of this break in the continuity of re-infections, hookworm infection is relatively very light in the agricultural villages of the Asansol Mining Settlement, since annually about 60 per cent. of the infection acquired during the favourable monsoon period is lost before re-infection begins again. This lessens the degree of soil infestation at the beginning of each successive favourable season, and thus the infection is kept down to a low level, in spite of defæcation habits which would otherwise favour a high degree of infection.

In the mines disused galleries, especially at the sides of streams, are used as defæcation sites. Conditions of temperature and humidity are highly favourable for the development of hookworm larvæ, but in spite of the fact that there is no desiccation, no activity of Scarabæid beetles, and no domestic animals to feed on the fæces, the stools rapidly disappear, being eaten up by cockroaches. It has been shown that when worm eggs in fæces are eaten by roaches only a few pass through in viable condition, the rest being destroyed by the grinding organs in the proventriculus. Only where numerous stools are daily deposited in a small area are any traces of old stools to be found. Roaches, therefore, play an important part in the control of hookworm infection in mines, and should be encouraged by trapping rats and mice, which prey on them. Only in stools collected in a much used place where the activities of the roaches could not keep pace with the deposition of fresh stools, was a relatively high number of hookworm eggs found. The average eggs per gramme of fæces of these stools were over six times as great as in those found in

scattered stools in the mine, and nearly five times as great as the average eggs per gramme of 75 people living in the coolie lines on the surface.

Variations in the Potency of Digitalis Preparations in the Tropics (II) (R. N. Chopra and P. De).—Last year the authors published a paper pointing out that clinical and biological observations and chemical assays of tinctures of digitalis show that they undergo deterioration rapidly in a warm climate such as that of India. They also showed that tinctures freshly prepared from *Digitalis purpurae* leaf grown in Kashmir, Northern Himalayas, were quite active; but, unfortunately, digitalis is not grown on a large scale in Kashmir. The therapeutic activity of the digitalis grown in Nilgiris is not great. It is grown on a commercial scale at Mungpoo, Eastern Himalayas, and when assayed biologically, different specimens show marked variations in their activity. These variations are probably due to the methods of drying and storing adopted. The outcome of this is that the practitioner does not know what is the strength of the preparation he is administering and is therefore faced with much uncertainty as regards the dosage he should employ and the therapeutic effects he may expect to obtain. Parke, Davis and Co. have imported into India a very powerful tincture, the strength of which is 50 per cent. greater than that of the ordinary tincture of digitalis. It is known as *Digifortis*. This preparation is free from fat, is sold in convenient one-ounce bottles and is further protected from oxidation by the use of carbon dioxide. It should not be used after twelve months after the date of manufacture, which is marked on the bottle. The dose advised by the makers is 8 minims, or 0·5 c.c., but the authors have given 30 minims diluted with a little water, on an empty stomach, without any discomfort to the patient or untoward effects. This preparation also gives good results in cases of heart failure with and without auricular fibrillation. The keeping properties of digifortis have also been tested and have been found excellent.

The Treatment of Syphilis by Benzo-bismuth (S. B. Surti).—Benzo-bismuth has given satisfactory results in the treatment of syphilis in its various stages, but its use is not to be advocated in cases complicated with either gonorrhœa or leprosy. In order to bring about a complete cure from a serological point of view and to maintain complete immunity from the disease, the directions accompanying each box of ampoules should be carefully followed. The advantages of this preparation are the following: (1) The small quantity that is injected not exceeding 1·5 c.c. (2) The ease with which the drug is administered, either intramuscularly or subcutaneously. (3) The painlessness after injection. (4) The uniformity of dosage. (5) The comparative cheapness. (6) No liability to toxic symptoms. (7) Complete solubility of the drug in a watery medium without leaving any particles in suspension.

External Medication in Leprosy (E. Muir).—Leprosy lesions are divided into three classes: (1) Lesions, one or more in number, spreading radially from the centres of infection. (2) Lesions, having the nature of a scar, left by the coalescence of the spreading areas. This character of a scar is not always complete, as the infection may spread from the more superficial layers of the corium, which are first affected, to the deeper layers. Nodulation may be superimposed on such lesions when conditions favour multiplication of bacilli in them. (3) Glove-trophic type, due to the contraction of the newly-formed fibrous tissue around the axis cylinders in the long nerve trunks. Treatment of leprosy is also divided into three divisions: (*a*) means which will cause improvement of the general health of the patient; (*b*) special remedies which may be given by the mouth or by injection; (*c*) external medication. The author has given his attention chiefly to the latter. He gives details of treatment by caustics and surgical treatment of nodules and redundant skin.

Some Observations on the Blood-Sugar after Treatment with Insulin in Diabetes (L. Ghoshal).—The summary of these investigations is as follows: The blood-sugar is higher than what is generally seen by the Folin Wu method, when it is done by the pancreatin and Folin Wu method combined. This excess of sugar is the combined sugar which is not easily breakable. The severity of diabetes depends on the amount of the combined sugar; the less the combined sugar the more severe the case and *vice versa*. Insulin treatment increases the combining power of the blood and thereby diminishes the sugar. It is possible that in this way it prevents the breaking down of fat and thereby prevents acidiosis.

Reviews.

"Protozoology." By Dr. C. M. Wenyon. Baillière, Tindall and Cox. Price 48s. net.

Two Questions of Priority.

This fine work of two volumes and no less than 1563 pages, besides prefatory matter, deserves a close review—which I, for one, am hoping to be able to give or obtain for it; but as I am shortly proceeding to India and the Federated Malay States, I may not have time to do justice to it before my departure; there are, however, two small points of priority in it which should be touched upon at once.

Questions of priority are always thorns in the flesh to those unfortunate people who feel themselves impelled to write textbooks. However just and accurate they endeavour to be they are open to attack by both parties who may be disputing any given question; and as the literature is sometimes very involved, they do not always have a happy time of it—just like those good people who attempt to settle family disputes. I have pity for Dr. Wenyon in this respect; but must confess that

so far as my knowledge goes, he has done ample justice to the utmost of his ability; though, with so much matter to survey, histories of discoveries are apt to be pushed into corners, especially in a book which is both zoological and medical. I think, however, that it may be useful to add the following notes to his, namely, on the subjects of (1) *Leishmania*, and (2) the very old malaria-mosquito discussion.

His principal historical notes on *Leishmania* will be found on page 397. They are perhaps too short when we consider the interest of the theme. The leading papers were published in 1903 and are correctly recorded. Leishman's paper of May 30, 1903, was certainly the first which accurately described the Leishman-Donovan bodies; but he had found them in only one case, in 1900, not "in cases," as Wenyon states. It is not quite clearly set forth in Wenyon's book that Leishman thought they were trypanosomes which had degenerated in dead tissue, although (as I said at the time) the absence of any stained flagella might have warned him against such a hypothesis. It was really the work of C. Donovan, in Madras, which led to the discovery that Leishman's parasites were quite new ones, and were not trypanosomes at all. He sent specimens to Dr. Laveran and to myself in the same year, and when we saw them we at once and simultaneously verified his supposition that we had a new organism to deal with. My first paper was *sent* to the *British Medical Journal* on October 24, 1903, but did not *appear* until November 14 (see *ibid.*, November 21, 1903, page 1359, for an editorial verification of that former date). In the meantime I had written to Laveran and told him of the discovery of the new parasite. He immediately informed me that he had come to the same conclusion; and his paper actually appeared in the *Bulletin de l'Académie de Médicine*, November 3, 1903. In this he suggested the specific name *Piroplasma donovani*. In a second paper, of November 28, I questioned this generic classification and, while accepting Laveran's specific name, proposed a new genus, *Leishmania*, which has now been adopted. Donovan's first observation of the parasites was made on April 9, 1903, and was quite independent of Leishman's observation, which had not then been published, and he deserved very great credit in the discovery. Leishman had observed the characteristic of the two associated chromatin bodies in the parasites, though his photographs did not show this. Donovan also had noted the same double nucleus; and it was his observations, carried out on a number of cases, which proved that we had a new parasite to deal with. In my opinion the discovery should, therefore, be attributed to both these distinguished observers. See also my paper with a coloured plate in the *Thompson Yates Laboratory Reports*, Vol. V, Part 2, 1903. F. Marchand had also seen the bodies and sent me a specimen of them later; but he thought that they were fragments of nuclear matter, and did not describe the double nucleus. J. W. Wright also found the bodies independently about the same time in a case of oriental sore and clearly described the double nucleus and named the parasites; but his paper was not published until December, 1903 (*Journ. Medical Research*, x, 472).

On pages 909-911 of his book Wenyon gives a very fair account of the *malaria-mosquito discovery* made in 1897-98. I see that in his bibliography, page 1485, he says that my *Report on the Cultivation of Proteosoma* was dated May 21 (which is quite correct) but that it was "issued October, 1898." As a matter of fact that was the date of the *official* issue which, as everyone knows, is often very different from the real date of issue. This was June, 1898, when thirty or forty advance copies of the work were sent from India to Europe, America and elsewhere—see my "Memoirs" (Murray, 1923), pages 288 and 332. Manson received a number of these copies and forwarded some of them to Italy, presumably in July, at the end of which month he gave a full address to the British Medical Association at Edinburgh, largely based on my report, regarding the whole of my researches, including the infection of healthy birds in July, notified to him by telegram. This address was printed with my drawings in the JOURNAL OF TROPICAL MEDICINE for August, in the *Lancet*, August 20, and in the *British Medical Journal*, September 24, 1898. My own report, already mentioned, contained full details of the new and difficult technique, with drawings of the mosquito-cycle of *Proteosoma*, and must have reached far and wide about the same time as Manson's address. In fact, no scientific discovery could have been more fully published than was this one during August and September, 1898. I may add that two papers by me and one by Manson, all announcing my work, but less completely, had already appeared, and that yet one more on the infection of birds appeared in October. These papers of ours hold complete priority in date of publication.

Yet Dr. Wenyon, with true scientific caution, dares only to remark, on page 910 of his book, that "Grassi may have been, and probably was, influenced and guided to some extent by what he had heard of Ross's discoveries." It is not a matter of mere probability, but of complete certainty, that Grassi's work was not only "influenced and guided to some extent" by mine, but was based entirely upon it, and that Grassi had not only heard of my discoveries, but had fully studied the literature. This is proved, apart from other evidence, by their own published admissions weeks before Bastianelli, Bignami and Grassi reached any real result at all—which was not until November, 1898, at earliest. In his very first publication of 1898, dated September 29 (*Policlinico*, October 1), G. B. Grassi refers to my work in the third and the sixth paragraphs of his article. In his next paper on the subject (*Lincei*, Vol. VII, page 235, seduta del 6 novembre 1898), Grassi mentions Manson and me several times and admits having received "alla fine di settembre," not only Manson's address to the British Medical Association, but also some of my proteosoma mosquitoes through

Manson from India, and a "Memoria del Ross," which could have only been my *Report on the Cultivation of Proteosoma* itself, forwarded to him by Manson. The first Italian result of any value at all was achieved by A. Bignami, in the experimental infection of the man Sola, which was proved on November 3 (but was only a repetition of my previous infection of birds in July). This was published by Bignami in his first paper of 1898 (*Bull. R. Acad. Med. d. Roma.*, November 15), of which a translation appeared in the *Lancet*, December 3 and 10; and in this paper (page 1462) Bignami not only admits receipt of my Report, but discusses the work of Manson and myself at length. The very first alleged observation of the mosquito-cycle of any of the malaria parasites by these workers was not recorded until December 4 (*Atti d. R. Accad. d. Lincei*, Vol. VII, page 313, inviata il 28 novembre, 1898). In this paper, Bastianelli, Bignami and Grassi not only refer to my original discovery of August 20 and 21, 1897, concerned with human malaria in "dappled-winged" mosquitoes, and published a year previously (December 18, 1897), but express the view that these mosquitoes were actually *Anopheles claviger*, and mention several times me and my work on *Proteosoma*, which had been fully published by Manson and myself more than four months previously. Dr. Wenyon mentions only one of these four papers in his bibliography and appears not to have read them. I shall be glad to show original copies of all of them to him or to anyone else who desires to see them.

If he requires further evidence that these observers were quite familiar with my work he will find it in my "Memoirs" (which also he does not mention in his bibliography), in the letters to me from Dr. Edmonston Charles from Rome, from November 4 to December 2 (pages 336 to 347 of my "Memoirs"). Charles visited Grassi and Bignami and described all that they were doing at the time. On November 4 he writes: "It has been a cause of surprise to me how very closely they have followed all that you have done, and how fluently they talk regarding the details of your work." On November 25, he wrote again to me: "I went to Professor Grassi's laboratory and showed him one of your preparations (third day, from the sparrow), showing pigments, &c., in the walls of the mosquito's stomach." This specimen had been lent to him for this very purpose by Manson. Then Charles adds: "He (Grassi) had before him *The British Medical Journal* with your paper of the 18th December, 1897, and seemed perfectly satisfied that your description of the mosquito referred to the *Anopheles claviger*." What more evidence is required? I shall be glad to show the originals of these letters also to anyone. It was not until a year and a half later that Grassi claimed in his "Studi di uno Zoologo" to have made the whole discovery "indipendentemente da Ross."

It is an obvious rule that priority in the discovery of the life-cycle of any biological group belongs to him who first demonstrates that life-cycle in any species of the group—often a very difficult task. It is absurd to pretend that those who afterwards find the same life-cycle in other members of the same group—generally an easy task—deserve an equal credit.

The life-cycle of the *Plasmodiidæ* in mosquitoes was discovered by Manson and myself, first partly in the case of *P. falciparum* in dappled-winged mosquitoes (obviously *Anopheles*) in 1897, and then completely in the case of *P. relictum* (*Proteosoma*) in *Culex fatigans* next year. The priority belongs to us—not to those who merely extended our results, months afterwards, by finding precisely the same life-cycle for other species of the group. I could easily have done the same thing but for the two interruptions which the Indian authorities imposed upon me just when I was able to undertake the work. I *did* do the same thing some months later in Sierra Leone, within a few weeks.

Unlike me, Bastianelli, Bignami and Grassi were able to name their mosquitoes owing to Ficalbi's recent work on Italian mosquitoes. They were able to stain their specimens by the Romanowsky method: while I was always too busy with my fundamental differential experiments which established the theory to attempt such details. It was owing to A. Bignami that *P. vivax* was also found to develop in *Anopheles*; and he deserves by far the chief credit in all the Italian work. Otherwise that work was secondary in nature and was simply on a par with exactly similar work which has now been carried out almost everywhere.

The discovery of conjugation in *Plasmodia* was made by W. G. MacCallum in 1897, quite independently of me, and enabled Manson to explain my initial results. It need not be discussed here; but it added, of course, a fundamental item to the general theory.

I must repeat that my work was done, not in the interests of general parasitology, but solely in order to diminish human sickness and mortality. It could not possibly have been carried further than it was in the short time allotted to me up to August 13, 1898, when I was obliged to leave Calcutta in order to investigate kala-azar in Assam.

The fundamental discovery was made, after more than two years' constant failures with many species of Culicines, on August 20, 1897, when I found the "pigmented cells" in the stomach-wall of a "dappled-winged" mosquito, bred from the larva and fed on a case of *Plasmodium falciparum*. This indicated both of the two unknown quantities, namely, the form and position of the parasites in the insect, and the type of mosquito concerned: and all that has been done on the subject since then has been an easy consequence of that fortunate observation. The discovery was fully published, with drawings of the cells and remarks by Manson and others, in the *British Medical Journal* of December 18, 1897, page 1786, nearly a year before Grassi and Bignami obtained definite results; and from that paper alone they, or anyone else, could have readily followed (and did follow) my work.

RONALD ROSS

Original Communication.

OBSERVATIONS ON THE PATHOLOGY OF THE CENTRAL NERVOUS SYSTEM IN MALIGNANT TERTIAN MALARIA, WITH REMARKS ON CERTAIN CLINICAL PHENOMENA.

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INTRODUCTORY.

ON a visit to England Professor Carly Seyfarth drew attention to certain interesting histo-pathological changes of common occurrence in the central nervous systems of cases which had died as a result of comatose malaria.

The observations of Margulis (1914), Dürck (1917), Fränkel (1917), Oesterlin (1920), Weingartner (1920), Marinescu (1920), Obregia and Popea (1924), Freifeld (1924), Dürck (1925), and Seyfarth (1926), have demonstrated that, in a large number of cases which have succumbed as the result of an attack of pernicious malaria, nodules may occur in the subcortical area of the cerebrum and more rarely in the cerebellum, which Dürck and Seyfarth consider may be of the nature of true granulomata. These characteristic lesions of the central nervous system would seem to place malaria amongst that group of diseases associated with multiple sclerosis. As little attention has been directed to the study of these by English workers, an examination of a considerable amount of brain material in our possession was undertaken. The possible far-reaching consequences of such lesions on the mental attitude and general nervous system of patients who have suffered from infection with *Plasmodium falciparum*, would seem to merit further careful clinical observation, especially in cases associated with previous attacks of coma.

THE PATHOLOGY OF THE CENTRAL NERVOUS SYSTEM WITH SPECIAL REFERENCE TO THE SO-CALLED "MALARIAL NODULES" OR "MALARIAL GRANULOMATA."

An examination of the literature of the histopathology of the central nervous system in malaria points to the fact that most of these observations have been conducted on cases which have succumbed to coma due to severe infections with *P. falciparum*. Post-mortem examination of malarial tissue in the pathological laboratory is often a very rapid event, consisting of the taking of a few brain smears or the removal of random samples of cortical tissue for diagnostic purposes. There is need for a more thorough and systematic examination of the various areas of the cerebrum, cerebellum, pons, medulla, spinal cord, &c., if the knowledge of the various changes and lesions in the central nervous system associated with malaria is to be increased.

Early observations on the pathology of the brain in malaria were made by the Italian workers, a good account of which is given in the monographs of Marchiafava and Bignami (1894) and Mannaberg (1894). The treatise of Laveran (1907) added further observations on the subject, and more recently Cerletti (1909) and Lafora (1912) have given details on certain cell changes.

Macroscopically in section the brain substance has a distinct smoky grey to brownish appearance due to the numerous pigmented parasites. Œdema, hyperæmia, and punctiform hæmorrhages of varying gradation are usually visible to the naked eye in the white matter. The meninges are slightly infiltrated, the vessels congested, and actual hæmorrhages may occur. Monier-Vinard, Paisseau and Lemaire (1916) have described the cellular reaction in these and found it to be chiefly lymphocytic in type. Polymorphonuclears are rare, but mononuclears and endothelial cells occur in increased numbers. In some cases under examination the subarachnoid connective tissue showed a diffuse small-celled infiltration which was chiefly perivascular, but also diffuse, that is, not confined to the perivascular spaces. Laveran described leptomeningitis, and Dürck has confirmed this. The most obvious microscopical feature in the cortical and subcortical areas of the cerebrum and cerebellum is the more or less complete blockage of the brain capillaries with parasitized red cells, which, owing to their tendency to clump together and stick to the endothelial cells at the periphery of the vessel, cause œdema, stasis, thrombosis and punctiform hæmorrhages. The capillary vessels seem to be increased in number, but this is possibly more apparent than real, since, owing to their engorgement, they are rendered more obvious. The endothelial cells lining the vessels are actively phagocytic; their protoplasm tends to swell and become vacuolated and contain substances of a fatty or lipoid nature. These cells become detached from the vessel walls in large numbers and may be seen in acute pernicious malaria circulating in the peripheral blood in various stages of degeneration. Further, they may aid very materially in the formation of thrombi in the minute capillaries. Lafora (1912) noted that the adventitial cells appeared to be greatly degenerated and pyknosed. Further, these cells showed a tendency to detach themselves and to penetrate the nerve tissues forming the so-called "Stäbchenzellen." In the adventitial spaces lymphocytes may be seen, and, according to Cerletti (1909), plasma cells sometimes occur in the lumen of the vessels and in the lymphatic spaces. The perivascular lymphatic spaces, according to Freifeld (1924), are more distinct, due to œdema, and he thinks these are the transition stage of a pericellular infiltration. Several authors state there may be extensive degeneration of the ganglion cells (Lafora, 1912; Dürck, 1926), which often show extensive chromatolysis with swelling and vacuo-

lation of the cytoplasm, loss of Nissl granules accompanied with degeneration of the medullated fibres. Lafora records the presence in the grey matter, and still more abundantly in the white matter, of astrocytes, large cells with thick insertion feet and showing very marked cystic degeneration of the protoplasm. Such cells are frequently described in other acute processes, e.g., paresis.

Punctiform hæmorrhages occur most commonly in the subcortical area, but also are found, though less frequently, in the cortex. It is a curious feature that the red cells in these areas seldom show parasites, although the neighbouring capillaries are packed with parasitized cells. Finally, we have the description of the so-called " malarial nodules " or " malarial granulomata " studied by Margulis (1914), and the other observers.

Various portions of the cerebrum of twelve cases of malignant tertian malaria, in which death was directly due to coma, were examined by us, and, in two of these, cerebellar tissue was also studied. Our object was to establish the frequency of these so-called " malarial nodules " or " malarial granulomata " cited by various German workers. In three, these lesions occurred in the subcortical area of the cerebrum, and in one they were also found in the cerebellum. One brain in particular, from which the photomicrographs appended in Plates I and II were taken, showed numerous lesions associated with punctiform hæmorrhages. These appear to have been noted first by Margulis (1914), and his observations were confirmed by Dürck (1917) and others. The most typical of these lesions in the present series occurred in the subcortical area of the cerebrum immediately subjacent to the deepest layer of the cortex; they were closely associated with the presence of numerous punctiform hæmorrhages in the subcortical regions of both cerebrum and cerebellum (*vide* Plate I, figs. 1 and 5, and Plate II, fig. 2).

In a characteristic nodule (*vide* Plate 1, figs. 2 and 3, which are taken at a magnification of approximately 200 diameters, and Plate II, figs. 3 and 4, at a higher magnification, namely, 500) there is a central capillary containing parasites surrounded by a perivascular necrotic area. Around this is a circle of proliferating glial cells, and, forming a ring around the glial cells and intermingling with them, are numerous red blood-cells with no parasites. Margulis (1914) noted the zone of extravasated red blood-corpuscles surrounding the perivascular necrotic area. The radially placed proliferating glial cells may show mitotic figures, and their nuclei are often bayonet-shaped, the whole arrangement of a typical nodule suggesting an aster. Margulis attributes these nodules to stasis and thrombosis in the neighbouring capillaries, and draws an analogy to the sclerosis which occurs in other organs due to attempted repair. He also found them in the optic thalamus. Dürck (1917 and 1925) has carefully studied and illustrated the pathology of these lesions. He considers the perivascular masses to be a result of the action of the malarial toxins, and that they can be regarded as a defensive inflammatory process. Further, he advances the view that they are comparable to true granulomata, which are capable of producing multiple sclerotic areas. He never failed to find these nodules in pernicious malaria. Changes seen in the brain of typhus cases somewhat suggest the malarial granuloma, but Spielmeyer (1919) has pointed out that the cell masses found in the brain of the former can be differentiated from those of malaria in that there was no necrosis and no radial symmetry of the glial cells. Fränkel (1917) noted nodules in one case, and Oesterlin (1920) in 24 cases found localized glial proliferation four times in the cerebrum, twice in the cerebellum, and once in both cerebrum and cerebellum. The same author describes them once in a case of tertian fever which succumbed to an intercurrent disease, and once in a case of blackwater fever.

Weingartner (1920) gives a good description of these lesions and states that the glial cells obviously proliferate around a previous capillary hæmorrhage—the latter being possibly due to stasis and thrombosis. Dürck, however, found them unassociated with hæmorrhages. Marinescu (1920) noted their occurrence in association with hæmorrhages, and stated they were due to an irritative reaction either from the hæmorrhage or malarial toxins, as nearly all of them were encountered on the course of a vessel.

Obregia and Popea (1924) described them in two cases, and also gave the size of these nodules, 30 to 150 microns in diameter. Freifeld (1924) in Russia reports them in pernicious and also from a case of quartan malaria.

Seyfarth (1926), in his description of the pathology of malaria, gives an excellent account of these nodules, emphasizing the fact that they are capable of producing a multiple sclerotic condition. He further states that, in the recovery of patients with such lesions, the brain can never recover the former quality or functions, and, apart from gross lesions, memory disturbances are marked in quite 50 per cent. of all serious cases.

In the case illustrated the most striking feature was the association of these so-called granulomata with numerous punctiform hæmorrhages. These hæmorrhages also occurred in the cerebellum of the same case, and figure 4, Plate I, shows one into the cortex of the cerebellum; fig. 5 in the same plate shows a hæmorrhage into the subcortical area of the cerebellum, with a commencing necrotic centre unaltered red cells being arranged in a circle around the periphery.

Fig. 1, Plate II, shows the blocking of a capillary in this brain with parasites. There seems undoubtedly to be a relationship between the hæmorrhages and the granulomata—the hæmorrhage being as it were the precursor. Fig. 3, Plate I, shows one of these nodules, and the one on the left of the photograph shows the capillary opening into the region of the lesion, which has already necrosed in the centre. Curiously enough, there are seldom para-

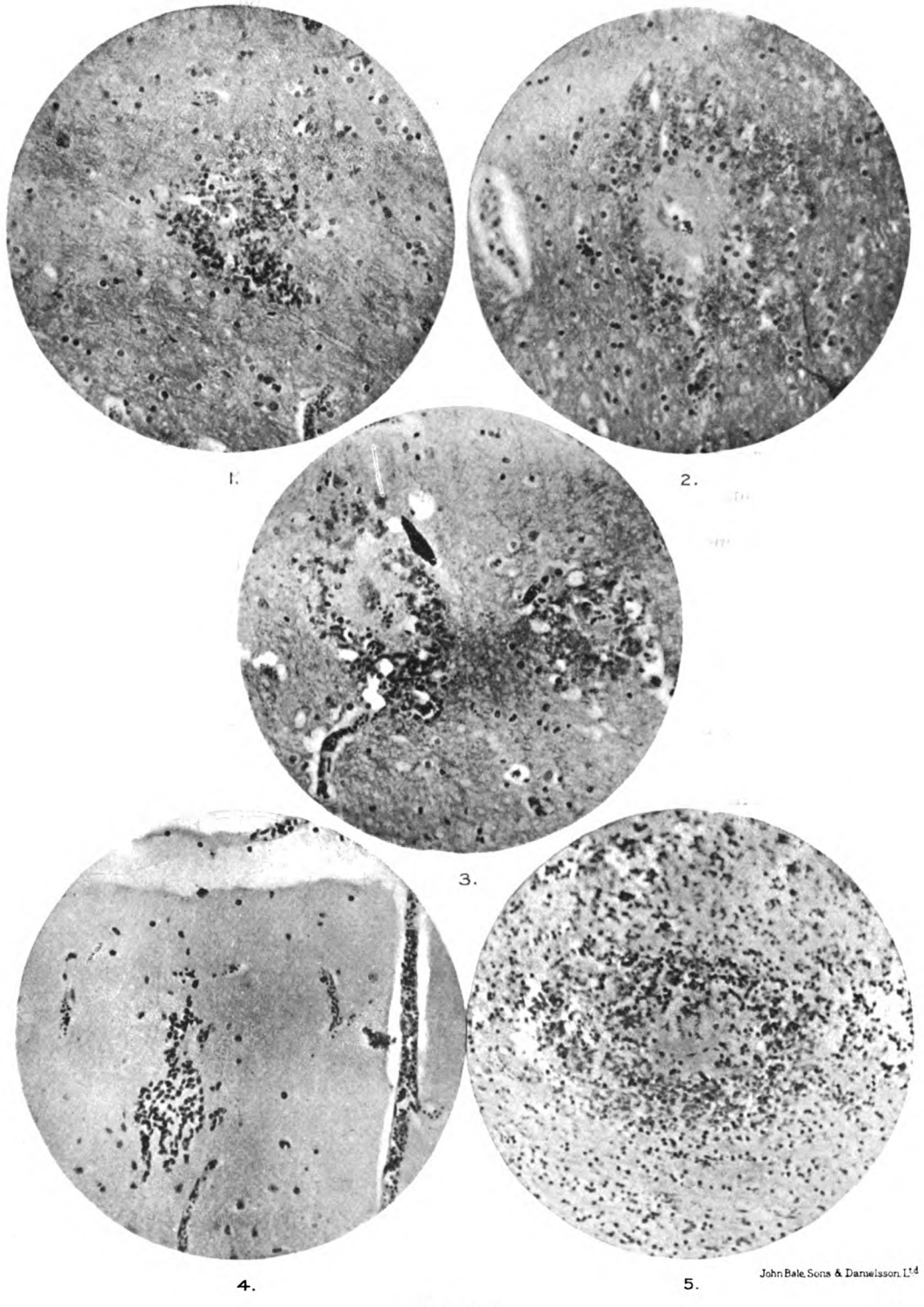
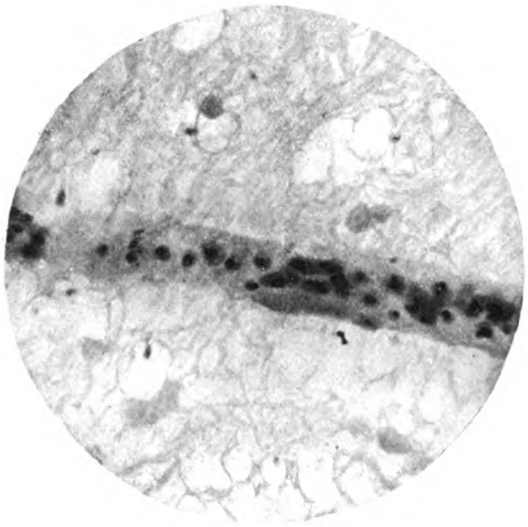
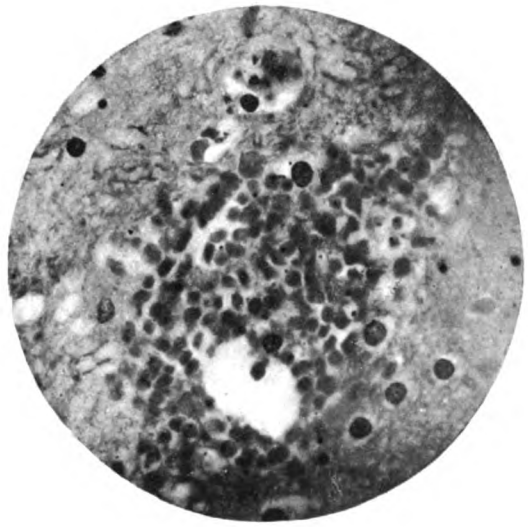


PLATE I. ×200.

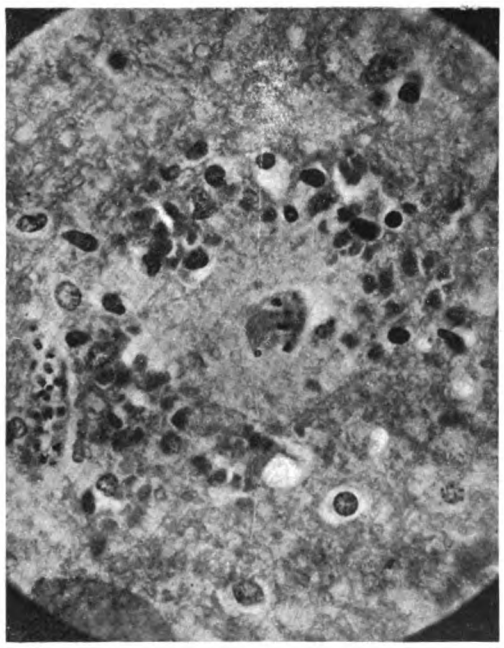
To illustrate article, "Observations on the Pathology of the Central Nervous System in Malignant Tertian Malaria, with Remarks on Certain Clinical Phenomena," by JOHN GORDON THOMSON, M.A., M.B., Ch.B., and S. ANNECKE, M.A., M.B., D.P.H.



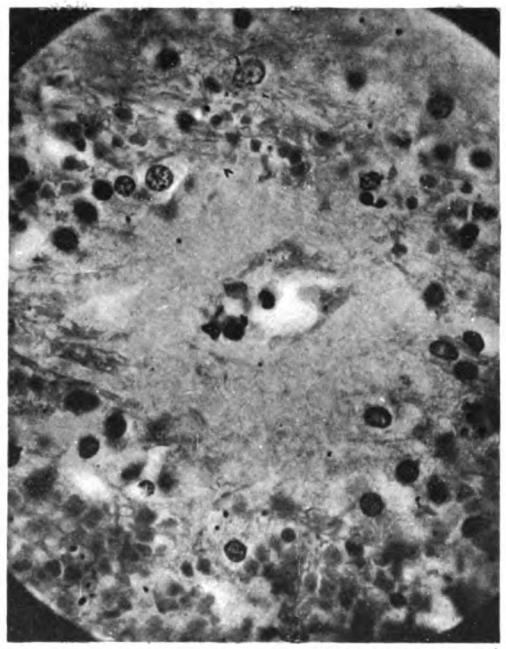
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2.



3.



4.

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PLATE II. ×500.

To illustrate article, "Observations on the Pathology of the Central Nervous System in Malignant Tertian Malaria, with Remarks on Certain Clinical Phenomena," by JOHN GORDON THOMSON, M.A., M.B., Ch.B., and S. ANNECKE, M.A., M.B., D.P.H.

sites in the extravascular corpuscles which form a ring around the necrotic area. It is difficult to explain the presence of these unaltered red blood-cells forming a ring around the outside of the nodule and intermingling with the circle of glial cells.

Although these so-called granulomata are possibly independent of hæmorrhages (Dürck 1925) and due to continued irritation from toxins, these observations lead us to consider they may frequently result from hæmorrhage. It might be presumed that, as central necrosis progressed in the hæmorrhage, it called forth on the part of the tissue a reaction stimulus, namely, glial proliferation. This would proceed until healing was complete, leaving a scar. Different stages of this process occur in the figures (*vide* Plate I, figs. 1, 2, 3, 4 and 5, and Plate II, figs. 2, 3 and 4). Unaltered red cells can be seen at the periphery intermingling with glial cells, especially in Plate II, figs. 3 and 4, showing the process is incomplete.

Neurological Sequelæ Resulting from Malaria.

The mental manifestations and general nervous symptoms of acute and chronic malaria have received a considerable amount of clinical attention, and, while numerous pathological studies have been made, it cannot in most instances be said that these have been correlated with the clinical observations noted before death.

While malaria, *per se*, can produce protean neurological phenomena, it is evident that many of those quoted were probably influenced by heredity, arteriosclerosis, cardiac disease, syphilis, alcohol, or some other concomitant infection which had been overlooked. Certain neuroses and psychoses may be coincident with an attack of malaria or even precipitated by it, but the primary causal factors may be due to other causes which can only be determined by further observations.

It is impossible to discuss fully in this communication the varied clinical manifestations attributed to malaria of the central nervous system, but, from a study of the pathology of brain lesions associated with coma, this disease in after-life might have far-reaching results.

For convenience in clinical studies of the nervous symptoms encountered it would seem useful to consider them in two groups, namely, those associated with acute malaria, and the various mental and nervous conditions of a more chronic character in patients no longer suffering from acute symptoms. In these two groups there may be an overlapping in that certain symptoms of the first may be carried over and become chronic in the second owing, as has already been indicated, to more or less gross lesions causing permanent damage and imperfect repair. It is this latter condition it is desired to emphasize owing to the pathological observations noted in this paper.

As a result of severe acute malaria the following definite clinical manifestations have been encountered by various authorities: attacks of an apoplectic nature, i.e., sudden unconsciousness with little or no premonitory symptoms, hyperpyrexia, convulsions, epileptiform seizures, uncontrollable sweating, chorea, bulbar paralysis, cerebellar disturbances, hemiplegia and paraplegia; localized nerve lesions confined to definite nerves such as the third or seventh, multiple sclerosis, amaurosis, peripheral neuritis, mental disturbances common in acute malaria such as coma, delirium, violence, aphasia, loss of memory, confusion, depression, excitement with violence or symptoms of insanity such as dementia præcox or delusional insanity, meningeal symptoms.

Although the severe pathological conditions associated with coma due to *Plasmodium falciparum* can produce the protean clinical symptoms encountered, many suggestions have been put forward to explain them, for example, punctiform hæmorrhages, œdema (due to the interference with the capillary circulation), foci of softening in the nervous system due to thrombi, toxins in the blood, alterations in the blood itself, malarial cachexia, focal anæmias produced by interference with the circulation, polyneuritis due to the action of circulating toxins in the peripheral nerves or the œdema of the spinal meninges resulting in a compression of the nerve roots and finally sclerosis of multiple character resulting from the repair of numerous necrotic foci.

As a general rule almost all of the above symptoms associated with acute pernicious malaria quickly respond to treatment, but it would seem that those mental and nervous symptoms of a more chronic character, attributed to previous malaria, require further study by careful clinical observation, correlated with the malarial history. Various degrees of mental impairment such as depression, loss of memory of varying degrees, &c., might conceivably result from the grosser lesions described above.

DESCRIPTION OF PLATE I.

Plate I.—Photomicrographs. Magnification approximately 200.

Fig. 1.—Hæmorrhage into subcortical layer of cerebrum, showing ruptured capillary with extravasation of red blood-cells and very early glial proliferation. This may develop into Fig. 2.

Fig. 2.—This shows typical necrotic area with centrally placed capillary surrounded by area of necrosis; proliferating glial cells intermingled with red blood-cells can be seen around this necrotic area.

Fig. 3.—Two areas of necrosis. Left hand one shows capillary coming into area from periphery (lower edge). Right hand one shows capillary in centre of area.

Fig. 4.—Hæmorrhage into cortex of cerebellum. Capillary traversing picture towards right edge plugged with parasites and pigment.

Fig. 5.—Hæmorrhage into subcortical layer of cerebellum. Central necrotic area surrounded by radially placed proliferating glial cells, interspersed with red blood-corpuscles.

DESCRIPTION OF PLATE II.

Plate II.—Photomicrographs. Magnification approximately 500.

Fig. 1.—Capillary vessel filled with pigmented parasites.

Fig. 2.—Hæmorrhage into subcortical layer of cerebrum showing red blood-corpuscles among which can be seen early proliferating glial cells.

FIG. 3.—Typical so-called granuloma in subcortical layer of cerebrum. Necrotic area with centrally placed capillary filled with parasites and pigment. Endothelial lining of vessel desquamated and shed; area of necrosis surrounded by proliferating glial cells interspersed with red blood-cells.

FIG. 4.—Typical so-called granuloma. Necrotic area in subcortical layer of cerebrum. Centrally placed capillary with area of necrosis surrounding vessel and outside this glial proliferation and red blood-corpuscles.

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FURTHER EXPERIMENTS WITH THE GONGYLONEMA OF CATTLE.—II.

By H. A. BAYLIS, M.A., D.Sc.,
A. LESLIE SHEATHER, D.Sc., M.R.C.V.S.,
AND
W. H. ANDREWS, D.Sc., M.R.C.V.S.

(I) INFECTION OF PIGS.

IN a previous paper (1926) we have recorded the negative result of an attempt to infect pigs with the cattle form of *Gongylonema* (generally known as *G. scutatum*, but believed, on morphological grounds, to be identical with the *G. pulchrum* of swine). This result was somewhat surprising, and we thought it desirable to repeat the experiment, which has accordingly now been done, this time with positive results.

On April 14, 1926, two pigs were fed with cockroaches (*Blattella germanica*) which had been experimentally infected with the larvæ of the cattle *Gongylonema*.

One pig, which may be called *A*, received 52 *Blattella* which had been fed with eggs from worms obtained from an experimental calf. Many of these cockroaches were very small, and they included only about 11 full-grown or nearly full-grown specimens. The second pig (*B*) received 28 *Blattella*, mostly full-grown, which had been fed with eggs from worms obtained from two experimental sheep. (The original stock of worms from which both the calf and sheep had been infected previously was derived from cattle in the Trentino, Italy.)

On July 30, 1926 (107 days after the infective feeding), both pigs were killed, and post-mortem examination revealed 14 specimens of *Gongylonema* in the mucous membrane of the mouth and œsophagus of *A*, and 9 specimens in that of the mouth of *B*. The individual worms were distributed as follows:—

Pig	Cheeks and gums	Sides of tongue	Œ-ophagus
A ...	5 ...	6 ...	3
B ...	5 ...	4 ...	nil

All the worms were small, but they appeared to be mature, many of the eggs in the uteri of the females already containing fully-formed embryos. The largest female (in pig *A*) was about 37 mm. long, and the largest male was about 24 mm. The largest female in pig *B* was about 31 mm. long. Although ample time appears to have been allowed for the development of the worms to maturity, these measurements are distinctly below the average for the form ("*G. scutatum*" naturally occurring in ruminants, but are in close agreement with those given by various describers for the supposed distinct species, *G. pulchrum* and *G. ransomi*, found in pigs (see Baylis, 1925). The left spicules of six males measured about 12, 11·9, 12, 9·5 and 10 mm. respectively.

The result of this experiment seems to lend considerable support to the view already expressed by one of us (Baylis, 1925) that the forms known

G. pulchrum, *G. ransomi* and *G. scutatum* are but a single species. It may perhaps be pointed out, further, that specimens of *Gongylonema* hitherto found naturally occurring in pigs appear (like those in the present experiment and like the few examples known to have occurred in man) not uncommonly to have been situated in the mucous membrane of the mouth and tongue rather than in the œsophagus. It is not unusual to find that a somewhat abnormal position is taken up by a parasite when it finds itself in an abnormal host, and correlated with this is the further fact that nematodes, in these circumstances, often fail to attain the size usual in their proper hosts. It may be suggested, therefore, that very possibly both the pig and man are but accidental hosts of the species which normally inhabits the œsophageal lining of ruminants (cattle, sheep, goats, &c.).

(II) Experiments with the Infective Larvæ.

(*a*) *Their Power of Living in Water.*

The life-history of *Gongylonema* involves an insect intermediate host—either one of several dung-feeding beetles or one of several species of cockroaches. In order to become infected, the final host must either swallow the insect containing the infective ("third stage") larvæ, or must come into contact by some means with these larvæ after their liberation from the insect. In all probability the former is, for most animals that harbour *Gongylonema*, the usual means of infection. It is almost certainly so in the case of rats, which will readily, and even eagerly, devour the cockroaches which harbour the larvæ of *Gongylonema neoplasticum*. In a former experiment (see Baylis, Pan and Sambon, 1925) rats were infected with the *Gongylonema* of cattle by administering to them, in water, larvæ dissected out from their intermediate hosts. It is clear, therefore, that it is not essential for the larvæ to be ingested while still contained in their capsules in the insect host, and to be liberated therefrom in the final host's digestive tract. Moreover, larvæ had sometimes been observed to remain alive in water for some hours in the laboratory.

It was thought desirable, therefore, to carry out some experiments in order to determine (*a*) whether the larvæ would actively emerge from their insect hosts if these happened to fall into the water, and (*b*) if so, how long the larvæ could survive in water.

Experiment I.—Accordingly, 12 cockroaches (*Blattella germanica*), from a batch previously infected by feeding with eggs of the cattle *Gongylonema*, were killed by one of us (H.A.B.) with as little damage as possible, by pinching the thorax, and placed in a small dish of tap-water at room temperature (April 6, 1926). On the next day (24 hours after the beginning of the experiment), no *Gongylonema* larvæ were found free in the water, but two of the insects were dissected, and one of them was found to be very heavily infected. The remaining 10 cockroaches were left in the water, and on the following day five *Gongylonema* larvæ were found free and alive in the water. The cockroaches were by this time decomposing, and on this day and each subsequent day they were transferred to fresh water, but otherwise the natural processes of decomposition and disintegration were not interfered with. The larvæ which had emerged each day were collected and placed in a separate small vessel of water, and kept by themselves at room temperature.

On the third day, the first five larvæ were still alive, and three more had emerged from the cockroaches. On the fourth day, two more were found. Living and active larvæ continued to emerge from the disintegrating bodies of the cockroaches in this way until the seventeenth day of the experiment (April 22). After this date, dead larvæ continued to appear for some days in the water containing the cockroaches, but no more living larvæ were observed. (Owing to the illness of the investigator, continuous observation ceased after April 26.) In all, at least 49 living larvæ emerged from the 10 cockroaches—an average of nearly five per cockroach—in a period of 17 days. These larvæ, transferred to clean water, remained alive for periods varying from four to eleven days. An interesting point is, that the length of life of the larvæ after emergence did not appear to be affected by the length of time previously spent in the submerged bodies of the dead cockroaches. Those which emerged towards the end of the period of the experiment lived, on an average, as long as those which had emerged at least 11 days earlier.

Experiment II.—A parallel experiment, somewhat modified, was made by one of us (A.L.S.) in the following way:—

On May 4, ten specimens of *Blattella*, previously infected by feeding with the eggs of the cattle *Gongylonema*, were killed by carefully pinching the thorax with forceps, and placed in a Petri dish of water. On the following day (as in experiment I) no larvæ were found in the dish. It was thought that a possible explanation of this was that in killing the cockroaches no damage had been done to the abdomen. The insects were therefore divided into two batches of five each, which were placed in separate dishes, this time in normal saline solution. One batch was left as before, while the abdominal walls of the other batch were torn with a needle. This was done at about 11 a.m. By 2 p.m. on the same day, three living larvæ were found to have emerged from the "torn" cockroaches, and by 4 p.m. three more. These were collected and placed in a watch-glass containing normal saline solution.

On the third day (May 6) nine more larvæ were found in the dish of "torn" cockroaches, but none in the "untorn" dish. Three cockroaches from the "untorn" batch were now removed to another dish and their abdomens were torn. One larva emerged within 15 minutes at room temperature. Larvæ being required for another experiment, the remaining two "untorn" cockroaches were now torn and placed with their original companions. There were thus again two dishes of saline, each containing five cockroaches. The insects were now

broken up, each into three or four pieces, and the dishes were placed in an incubator at body temperature. This, it had already been found, caused a great increase in the activity of the larvæ. The dishes were allowed to stand for half an hour in the incubator in order to become warm, and were then taken out in turn at intervals and searched. The larvæ were collected and the dishes returned to the incubator. After each dish had been searched three times no more larvæ could be found. The total number collected from the two dishes was 114—an average of about 11 larvæ per cockroach.

It appears from the results of experiments (I) and (II) that the larvæ may be unable to escape from the abdomen of the host until some disintegration of its wall has taken place. This disintegration begins to take place naturally by the second day at room temperature in tap-water, but is possibly somewhat retarded by the use of normal saline solution. The emergence of the larvæ is greatly hastened by raising the temperature to 37° C., doubtless as a result of their increased activity.

From these experiments it is evident that drinking water must be taken into consideration as a possible source of infection with *Gongylonema*, not only for animals but for man. Should the intermediate hosts fall into a suitable water supply they will, sooner or later, liberate the contained larvæ, which may then be ingested by animals or human beings drinking the water. One fact, however, renders this mode of infection somewhat unlikely to be common. The larvæ, when they find themselves in water, make no attempt to swim or float, but sink at once to the bottom, where they remain, at ordinary temperatures, usually in a closely coiled and sluggish condition. The water, therefore, must probably be very shallow for the worms to be easily taken up with it.

(*b*) *The Question of Skin-penetration*

There remained the possibility that ingestion by the mouth might not be the only way of acquiring infection through contaminated water. It was possible that the larvæ might have the power of penetrating the skin or mucous membranes of animals when in contact with the water, as is known to be the case with certain nematodes of other families. Accordingly, the following experiments were made.

(1) Eleven third-stage larvæ, obtained by dissection from experimentally-infected *Blattella*, were placed in a drop of water on a piece of shaved and freshly excised skin from the abdomen of a rat. This had been stretched over a hole in a piece of cork and floated on normal salt solution at a temperature of 37° C. (Goodey's method). This was done at about 12 noon, and the larvæ were watched at intervals. They became very active at the raised temperature, but appeared to make no attempt to penetrate the skin. At 2.30 p.m. all the eleven larvæ were recovered from the surface, none having penetrated into the skin.

(2) Two larvæ were placed, under similar conditions, in water on the inner surface of a fresh piece of œsophagus from a rat. They were kept under observation for about half an hour, but were not seen to make any attempt at penetration.

(3) Five larvæ were similarly placed on the lining of the cardiac (stratified epithelium) portion of a rat's stomach. Kept under observation for about an hour, they appeared to make no attempt at penetration. As often as the drop of water began to dry up, they became very sluggish, reviving promptly when more water was added. This appears to indicate that the reason for their non-penetration is not (as Goodey has found to be the case with hookworm larvæ) that they require a very shallow film of water in order to obtain the necessary purchase.

(4) Five larvæ (collected overnight and kept in water at room temperature) were placed (using the same technique as indicated above) in water on a piece of the lining of a fresh sheep's œsophagus. This œsophagus had been conveyed in normal saline straight from the slaughter-house to the laboratory. Four more larvæ from the same batch were similarly placed on a piece of the lining of another sheep's œsophagus, equally fresh, but kept without saline. In both cases the larvæ were kept under observation for over an hour, but showed no disposition to penetrate the epithelium.

These experiments, though necessarily carried out on a small scale and under artificial conditions, seem to afford some evidence that the larvæ of *Gongylonema*, at least when in water, do not possess the instinct or the power of directly penetrating the skin or the mucous membrane of the upper portion of the digestive tract of their final hosts.

(*c*) *The Question of the Route of Migration within the Body of the Final Host.*

It is a question of considerable interest how the larvæ of *Gongylonema*, once having entered the body of the final host, come to take up the position in which the adult worms are usually found: namely, in the thickness of the epithelium of the œsophagus, stomach or buccal cavity. Upon this question we have been able to throw no important light, our experiments having given only negative results. It seems probable from the experiments described in the last section that the larvæ do not, upon being ingested, immediately penetrate the lining of the upper part of the alimentary tract. It is possible, however, that they do so lower down, and then migrate to their final position, either through the tissues and cavities of the body or by way of the blood-vessels, as do many other nematodes.

In order to test the possibility of migration through the blood-stream, one of us (A.L.S.) performed the following experiment:—

On May 6, 114 living and active larvæ of the cattle *Gongylonema* were placed in 6 c.c. of normal saline solution. After thorough shaking up, 3 c.c. of this suspension of larvæ were injected into the right jugular vein of each of two sheep. These sheep were killed on July 30 (85 days after the injection), but no evidence of infection with *Gongylonema* could be found on post-mortem examina-

tion. The negative result of this experiment suggests that the normal route of migration is not by way of the blood-stream, but too great importance should not be attached to it.

SUMMARY.

(1) Two pigs were successfully infected with the common *Gongylonema* of ruminants by feeding them with cockroaches (*Blattella germanica*) which had, in their turn, been experimentally infected by feeding with the eggs.

The facts that the adult worms obtained from the pigs occurred mainly in the epithelium of the mouth and tongue, and that they were of small size, comparable with that described for the supposed distinct species recorded as naturally occurring in pigs, but considerably below the average for the ruminant form, suggest that:—

(*a*) The ruminant form, *G. scutatum*, is (as has been suggested on morphological grounds) indentical with the pig form, *G. pulchrum*.

(*b*) The pig and, by analogy, man are probably "accidental" hosts for the species.

(2) The infective larvæ of the *Gongylonema* of ruminants have been shown experimentally to emerge spontaneously from their insect intermediate hosts when these are killed and placed in water. The larvæ are capable of living in water for some days, and water must, therefore, be looked upon as a possible source of infection for the final hosts.

(3) Experimental evidence suggests that the larvæ, when in water, do not possess the instinct to penetrate the skin or mucous membranes of animals with which they come into contact.

(4) No definite light has yet been thrown on the question of the history of the infective larvæ after entry into the final host, or their route of migration within the host's body before reaching their definitive position. The result of an experiment in which larvæ were intravenously injected into sheep seems to suggest that they do not normally migrate by way of the blood-stream.

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YELLOW FEVER CONTROL IN WEST AFRICA.

By Prof. W. H. HOFFMANN, M.D.

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AT the present day, when the greater part of the coast of West Africa, between Senegal and the Congo, is an endemic centre of yellow fever, it may be allowed to consider the means which we use to-day and which should be applied to prevent the disease from spreading and becoming once more a danger for the world, as it has been for centuries.

It may be, and it is probable, that West Africa was the oldest endemic centre in the world, but it was too far away to attract attention. To-day the communications have become easier; to-day the disease is quite near to the great highways of the world's traffic and to the great capitals of the world's commerce; and yellow fever has always been found following the world's traffic and commerce.

On the other hand our knowledge of the disease and its prevention is much better now than it used to be in olden times; quite sufficient indeed to allow of a perfect control, at least in civilized countries where it is possible to make the necessary hygienic measures practically effective.

This seems doubtful in Africa and eventually the disease might spread in the interior, even though its transport by sea should be preventable by the ordinary quarantine measures.

The fundamental methods in the control of yellow fever are the classical anti-mosquito measures which were worked out in Cuba in 1901, on the discovery of Finlay, made and published in 1881, that the only way of transmission of yellow fever is the transmission by the mosquito *Aëdes ægypti*, formerly known as *Stegomyia fasciata* or *calopus*. If in a certain place we can reduce the number of these mosquitoes under the critical level, if perhaps only in 1-2 per cent. or even 5 per cent. of the inspected houses larvæ are present, then yellow fever does not find the conditions to spread in an epidemic form. This can be done regularly and without great difficulties, as experiences in America have shown, with the result of immediate eradication of the disease. Not to profit by these experiences would be a neglect of elementary hygienic rules.

Aëdes ægypti is present everywhere in tropical Africa, on the Mediterranean coasts, in Southern Europe and Asia Minor; it is abundant in India and in the Far Eastern countries. The possibilities for the propagation of yellow fever, if once imported, are enormous in the tropics and subtropics of the Eastern Hemisphere.

Now we know that yellow fever epidemics generally originated from the big centres of traffic with their numerous and non-immune population, whence they would spread over the country.

This observation shows how the great problem to attack yellow fever in Africa may be resolved successfully, difficult or even impossible as it might appear at first sight to one acquainted with sanitary conditions and hygienic work in Africa.

It must be the first aim of the health authorities to reduce the number of mosquitoes in the principal harbours of the whole coast in such a way that yellow fever cannot spread further in places which are the primary and most dangerous centres. This should be possible with some energy, as it corresponds to the great danger which is imminent for the whole world.

Of course, it will be necessary that the clinical and pathological experts look most carefully for all suspicious cases, so that they cannot escape observation. Though generally it will be too late for isolation, or even for the specific treatment, because the first three to four days of the disease will already have passed, still it will be possible at a very early moment to deal with the house of the patient in order to kill the infected mosquitoes. It will be possible also to apply our second and very helpful though supplementary measure in combating yellow fever, by injecting all the persons from the environment of the patient with the yellow fever vaccine prepared from killed cultures of *Leptospira icteroides*, which will immunize those who possibly were exposed to the bite of the infected mosquitoes in the neighbourhood of the first case. Thus the disease must find a wall of non-susceptible persons which it cannot pass.

Vaccination should be made obligatory for all non-immunes, especially Europeans, who arrive in the country; or better still for all foreigners without exception.

The diagnosis of the disease in the benign form, as it presents itself in endemic areas, is not easy, especially in coloured people and in children. More care should be applied to good clinical observations of suspicious or doubtful cases, especially when occurring in foreigners, and of exact anatomical studies of all the fatal cases in which another cause of death is not absolutely obvious.

It is difficult to know how far the endemicity may reach now to the interior of Africa. Still, this is a question of serious importance, because the greatest danger, almost impossible to check, seems to be at the present moment the transport of the disease from the endemic centres of the West African coast to other territories with a large non-immune and highly susceptible population in Central or East Africa, where the importation of yellow fever would certainly produce murderous epidemics, which it would not be possible to combat by adequate hygienic measures.

The prophylactic measures against the transport by sea are much easier.

There is not much danger that an infective case of yellow fever should come to Europe, because the incubation period is less than six days and the infectivity is limited to the first three days of the disease.

The *Aëdes ægypti*, however, becomes infective twelve days after sucking the blood of an infected person. Once infected it remains infective for weeks and months. Such mosquitoes might easily reach Europe and other countries with the steamers.

The principal measures to be adopted by the neighbouring countries which are menaced, besides the regular quarantine measures and fumigation of the ships, are the same local measures against the *Aëdes ægypti* in the principal seaports, so that in the case of importation of yellow fever patients, or even infected mosquitoes, the disease cannot spread owing to the absence of the transmitting agent.

The control of the yellow fever mosquito is quite different from the well-known measures used in the anti-malarial campaign.

Aëdes is quite a domestic mosquito. It will never leave the house of man or its immediate neighbourhood. Here the female sucks blood and here she lays her eggs in the small water containers, which are found in every house, especially in a hot climate, if there is no central water supply.

The eggs will develop in about a week into a new generation of mosquitoes.

The most effective way to attack the *Aëdes ægypti* is by eliminating the domestic breeding places so that the eggs cannot be deposited and the larvæ cannot develop.

Small water containers should disappear or must be emptied at least every five to six days. The tanks which are indispensable must be screened by mosquito wire net. Where that is impossible, in America the best results have always been obtained by small fishes, of which one or two are put into the containers and which eat the larvæ. It is recommended to use fishes of the country which, by a study of their habits, may be found apt for this purpose.

The best measure against *Aëdes* is always a good pipe-water supply.

Two or three months of a vigorous campaign against the mosquitoes will generally be sufficient to reduce their number so that no epidemic is possible.

Experience has shown that the anti-mosquito measures cannot be left to the population, because even in civilized countries they will not co-operate in this work.

So in Africa still more this work has to be done under the responsibility of the health authorities and officers, by specially trained mosquito brigades, which have to go from house to house to apply the necessary measures and come back regularly every week to control the result of their work.

If these measures are applied systematically in the big centres of traffic, it will generally be possible to control the disease so that it will not spread in epidemic form, and that the endemicity will be finished in a reasonable space of time, during which the control measures have to be continued.

No special campaign is necessary for the smaller places without traffic. Here the yellow fever has always the tendency to disappear spontaneously for want of susceptible persons, because those who have once had the disease will be immune for the rest of their life.

With the modern measures of yellow fever control, mosquito campaign, especially in the big centres of traffic, early diagnosis and isolation of all the cases, protection of non-immunes by vaccination, serum treatment of early cases, with good will and energy of the responsible authorities, I think that even under the difficult conditions in Africa it will be possible to successfully attack

the disease with the final result of its complete eradication.

Immediate unanimous action is indispensable; any delay might be of disastrous consequences for the whole world. Everything possible should be done now in order to avoid in the great world of modern commerce the reappearance of yellow fever with all its horrors of bygone centuries, especially in the least protected countries around the Indian Ocean.

An unusual Type of Pemphigus; Combining Features of Lupus Erythematosus (F. E. Senear and B. Usher, *Arch. Dermatology and Syphilology*, June, 1926).—The peculiar clinical features of the dermatosis described make it difficult to determine beyond dispute its proper place among cutaneous disorders, embracing as it does features both of pemphigus and lupus erythematosus, and yet not conforming to the ordinary picture of either one of these conditions; it is possible that the disease presents a toxic eruption which should be regarded as a transition between lupus erythematosus disseminatus and pemphigus.

The Epidemiology of Malaria in Palestine. A Contribution to the Epidemiology of Malaria (I. J. Kligler, *The American Journal of Hygiene*, May, 1926).—In this paper an analysis has been given of the factors entering into the epidemiology of malaria in Palestine and an attempt has been made to analyse these factors in order to ascertain which of them are principally concerned: (1) in the annual recurrence of epidemics, and (2) in the seasonal occurrence of these outbreaks. In the first part of the paper the author has shown that the distribution of the rain, as well as the total annual precipitation, are chiefly responsible for the yearly variation in the number and extent of breeding places and hence of anopheles; and that, because the temperature and humidity show but little variation, the rain factor is the principal one which predetermines the occurrence of an epidemic in any given year or at any given place. The carrier and a susceptible population are present in abundance at all times, but the intensity of an epidemic in a given locality naturally depends on the size of the new susceptible population. With regard to the seasonal occurrence, it is shown that it depends on the anopheles vectors, which in Palestine have limited seasonal prevalence. The spring epidemic is due to *Anopheles clutus*, which has its maximal development during May and June. The autumn epidemic is presumably due to *A. sergenti*, which has its maximal development in September, but *A. clutus*, which has another optimal period in October, undoubtedly also plays a rôle in it. A hypothesis is advanced to explain the predominance of *Plasmodium vivax* in the spring and the early summer and of *P. falciparum* in the late summer and early autumn. It is argued that just as the different species of anopheles have different temperature optima, so the different species of parasites may also have different temperature optima.

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TULARÆMIA.

The source and character of the infective agent in many cases of septicæmia often present very puzzling characters and are difficult of recognition. In fact the term cryptogenic septicæmia has been

employed to connote just these conditions, and as an example may be quoted sporadic cases of septicæmic plague. Within recent years cases of this nature have been observed to occur in various countries in persons whose avocations have brought them into contact with rodents, and particularly with rabbits, such as rabbit fanciers, farmers, gamekeepers, poultrymen and meat cutters. The cause has now been ascertained to be the *Bacterium tularense*, and the resulting infection is known as tularæmia. This organism was first described by McCoy in 1910, when investigating plague among ground squirrels, which are the wild rodents of California. Many of these animals suffered from a plague-like disease in which the pathological lesions found presented a close resemblance to those of plague, but in which *Bacillus pestis* could not be found. By subcutaneous, cutaneous, nasal and intraperitoneal injection the disease could readily be transmitted to guinea-pigs, rabbits, mice, monkeys and gophers, whilst rats were moderately susceptible and cats, dogs and pigeons appeared to be immune. The lesions produced in subacute and chronic infections strongly resembled those of tuberculosis. McCoy suggested that in natural infections the flea might serve as a carrier.

The organism is a minute rod, encapsuled as observed in infected tissue, though no distinct capsule can be seen in artificial cultures. No growth occurs on simple media, but the addition of egg-yolk, serum, blood or glucose to agar constitutes a medium on which a scanty growth of low virulence is obtained. The addition of a piece of rabbit spleen or of the spleen of the affected animal stimulates the growth and increases the activity of the organism The amino-acid cystin is a potent activator of its growth, and on serum glucose agar containing ·02 per cent. of cystin luxurious growth is obtained.

The first human case of tularæmia appears to have been recorded by Wherry and Lamb in 1913, the patient being a man who was employed as a meat cutter in Cincinnati, infection having taken place through the eye, and several cases of tularæmia conjunctivitis have subsequently been recorded.

The symptoms of tularæmia are those of a general septicæmia, with long-continued and debilitating fever, and with or without lymphadenitis in the neighbourhood of the infective focus. It often presents a fatal termination.

Even when not fatal, tularæmia is a serious disease, incapacitating the patient for several months. One very striking feature of this disease is the very large number of infections which have occurred among laboratory workers who have handled the cultures or been intimately connected with the study of the disease. The proportion attacked is probably unequalled in the history of the investigation of infectious diseases, and this fact would indicate the high infectivity of the organism and the great susceptibility of man. It is suggested that in these laboratory infections the portal of entry of the organism is in the hands, as in some of the cases there were enlarged, painful and tender lymph glands in the epitrochlear and axillary regions.

The infection has been transmitted experimentally from animal to animal by certain biting flies, by fleas, by lice, and by bed-bugs. The vector most commonly effective in the ordinary transmission of the disease from wild rodents to man appears to be some blood-sucking fly such as *Chrysops discalis* or *Stomoxys calcitrans*.

It is quite possible that human infections have hitherto sometimes escaped recognition. The diagnosis may be confirmed by blood-culture, by agglutination and by complement-fixation tests. As regards prevention of the disease it may be pointed out that there are comparatively few biting insects which feed indifferently upon small rodents and upon the human subject, otherwise tularæmia would become a widely prevalent human disease occurring in severe epidemics like plague. Susceptible animals and suspected insects should be thoroughly studied, so that effective measures of control may be evolved. Meanwhile it is unwise to handle wild rodents, dead or alive, especially in the warm seasons of the year, when they are plentifully infested with blood-sucking insects. Lastly, for their own protection, all laboratory workers engaged with this disease and its causal organism should wear gloves, and thus avoid contact of infected material with the hands.

So far as we are aware, the only cases which have occurred in this country have been restricted to laboratory infections, but that tularæmia may possibly be a disease of widespread geographical distribution and when recognized may have masqueraded under other names is suggested by a critical examination of the recent work of Ohara in Japan. His published descriptions deal with an acute febrile disease which was transmitted to man by wild rabbits in the Abukuma Mountains, to the north-east of Tokyo. He observed the condition in a mother and two sons who were all simultaneously affected after skinning, dressing and eating a wild rabbit. From inquiries it was learnt that a disease of this nature had been prevalent among the villagers of the Abukuma Mountains for the past twenty years. Ohara gained the impression that the infection is by no means uncommon in that district.

From a critical study of the epidemiological, clinical, bacterial, pathological and experimental observations of Ohara, together with the results obtained from the investigation of material supplied by Omara, Francis and Moore, of the United States Public Health Service, have been led to the conclusion that Ohara's disease occurring in Japan and tularæmia occurring in the United States are in every way identical.

They found that the clinical and epidemiological characteristics of Ohara's disease agree even in minor details with those of tularæmia. Further serums collected from his cases and forwarded by Ohara agglutinated *Bacterium tularense*, whilst glandular tissue from one of Ohara's human cases caused tularæmia in laboratory animals in the United States from which *Bacterium tularense* was recovered and reciprocal agglutination absorption

tests failed to distinguish any difference between the Japanese and American cultures.

In view of the close association between tularæmia and the wild rabbit and of the wide geographical distribution of this animal it may be expected that in the course of time cases will be recorded from other countries and Australia would certainly be expected to rank among them, for, as is well-known, the wild rabbit is there so prevalent as to constitute a national pest.

F. E. T.

Annotations.

Studies on the Serology of Leprosy, II. Nitric Acid Precipitation (Bruck, modified) (H. W. Wade, *The Philippine Journal of Science*, May, 1926).—A study of the serum of leprosy has been undertaken by means of certain non-specific tests and by other means, in the hope of throwing more light on the changes occurring in this disease. Results with the nitric acid reaction of Bruck, somewhat modified as to technique, are reported. Of 100 lepers' sera tested, 93 were read moderately to very strongly positive, and none was negative. Antileprosy treatment apparently reduces the degree of reaction, it being very strong in a much smaller proportion (7 per cent.) of the cases that have been under treatment than in new untreated cases (44 per cent.). The results in ten cases clinically and bacteriologically negative were essentially the same as in the treated cases, the explanation for which fact is not apparent. The reactions in 21 sera giving some degree of the Wassermann reaction was essentially the same as in the untreated group. Of a group of 16 non-lepers, only three gave negative reactions, these among the professional staff, while two (labourers) were strongly positive. The frequency of weak reactions in apparently healthy individuals leads to speculation as to whether these weaker reactions are due to any abnormality. That this reaction is of no value in the diagnosis of a particular disease is obvious; that it does not depend upon the presence of syphilis (or yaws) alone, and does not have the significance of the Wassermann reaction, is again shown.

The Non-surgical Constipations, Functional and Mechanical (Max Erdheim, *Medical Journal and Record*, May 5, 1926).—The nonsurgical constipations may be divided into two groups, namely, those that are of mechanical origin and those that are of functional origin. But even in those cases in which roentgenological study shows a definite mechanical defect, the functional factor, i.e., a disturbance of the balance of the nervous control, is often the essential cause of the constipation. A knowledge of the physiological action of the nerves that control the intestinal movements is essential to an understanding of the functional constipations. The most rational classification of these constipations is that of Gustav Schwarz. It is based upon the present-day conception of the nervous control of the movements of the colon. According to this classification the functional constipations are divided as follows: (1) the ascending type which is commonly associated with pericæcal adhesions, typhlitis, chronic appendicitis, and cæcum mobile; (2) hypokinetic constipation, due to an underactivity of the motor vagal fibres that pass directly from the intestinal serosa to the muscular layer, resulting in spasms; and dyschesia or rectal constipation, due to a habitual suppression of the physiological urge. The principal causes of the functional constipations are an insufficiency of roughage in the diet, diminution of the endocrine secretions that normally augment peristalsis, constitutional depression of the excitability of the plexus of Auerbach, overactivity of the vagal innervation and habitual neglect of the physiological call. Whenever a patient gives constipation as his principal complaint a detailed study must be made to determine the specific causative factors operative in the individual case. The most important part of this study is the roentgenological examination. A routine treatment for the functional constipations is illogical. Rational therapy is dependent upon the specific ætiological factors in the given case.

Effect of Parathyroid Hormone on Certain Signs and Symptoms in Tuberculosis (B. Gordon, J. L. Roark and A. K. Lewis, *Journal of the American Medical Association*, May 29, 1926).—To a series of sixty tuberculous patients parathyroid hormone injections were given to determine the effect on certain signs and symptoms common to this disease. There was improvement in the strength, increased warmth and lessened muscular and pleuritic pain. In some instances, there was also a favourable effect on laryngeal tuberculosis. The effect on cough was variable; the dry, hacking cough was often aggravated, the productive coughs were often less troublesome during treatment, and there was decreased expectoration. There was a favourable effect on dyspnœa. The most striking objective feature was in the control of pulmonary hæmorrhage. This was relieved quite constantly. There was also a decrease in the œdema of the arytenoids and other structures involved in laryngeal tuberculosis, with some evidence of healing. In pleurisy and pulmonary congestion there was evidence of decreased râles following the administration of the parathyroid hormone. In the Roentgen-ray examination, there was a suggestive clearing of the lung fields, but no evidence of calcification. In general there was a favourable effect on the condition of the patients as shown by increase of appetite, gain in weight, and lowered temperature and pulse-rate. The untoward features

were arthritic pains, dryness of the throat, increased coughing, palpitation, weakness and periods of elevated temperature and pulse with loss of weight and appetite, and were usually due to over-dosage. These phenomena were generally relieved following the withdrawal of the medication, and seldom re-appeared during moderate dosage. There appears to be no evidence that a favourable effect on pulmonary tuberculosis is obtained from maintaining a high calcium content in the circulating blood.

Studies on the Serology of Leprosy, I. *The Wassermann Reaction in Leprosy* (E. V. Pineda, *The Philippine Journal of Science*, May, 1926).—The Wassermann reaction was made, using Kolmer's method, on the sera of 500 lepers, and, for comparison, about 150 of these were also tested by an ordinary method, using both plain and cholesterinized antigens. In the latter method it was found necessary to adjust the antigen dose closely, as an increase from the dose used, 2½ antigenic units to 4, resulted in an increased number of weakly positive or doubtful reactions. The 500 cases considered include 66 untreated new admissions and cases that were under treatment at the time or that had been treated. Among the latter 59 were negative and 82 were cases of lepra reaction. Of the total group 85, or 17 per cent., gave reactions that were positive in some degree, the doubtful plus-minus reactions being included. Of these, 58 were in the group of 67 cases that were under suspicion of yaws (42 cases) or syphilis (25 cases). In the remaining 27 positive cases neither history nor signs of yaws or syphilis could be elicited. Data on the clinically framboesial and syphilitic groups are given. The particularly interesting group without clinical evidence of treponematous infection is subdivided into those without and those with lepra reaction, 11 and 16 cases respectively. Of the former, 8 gave strongly positive Wassermann reactions and of the latter but one. Further, the 3 weak reactions of the former group were in cases of slight leprous involvement, and the reactions were negative on retest. The one strong reaction in the latter group was in a Moro, particularly liable to yaws.

Nature and Availability of the Plant-Food Constituents of Philippine Guano (M. Tirona, *The Philippine Journal of Science*, May, 1926).—Guano is being used on a large scale as a fertilizer by sugar planters in the Philippines, and extensive working of guano deposits in the country is in operation. Thousands of tons of guano, mainly the excreta of bats, are being mined every year, the greater part of which is sold to local manufacturers of fertilizer who use this material mainly as a source of phosphoric acid for their brands of fertilizer; the remainder is disposed of to farmers, who apply it directly to the soil. The ever-increasing demand for local guano renders it important therefore that its nature and the availability of its plant-food constituents be known; it was with this end in view that this investigation was undertaken.

Philippine guanos are, in general, phosphatic, the phosphorus existing mainly as phosphates of iron and aluminium. In freshly deposited guanos, however, the phosphorus exists mostly in immediately available form. The water solubility of nitrogen in Philippine guanos ranges from 16 to 60 per cent. of the total, of which from 3 to 15 per cent. is derived from ammonia, ammonium salts, simple amids, soluble proteids, &c., and the remainder from nitrates. An important characteristic of Philippine guanos is therefore, the relatively large proportion of nitrogen as nitrates. Potash is invariably present in Philippine guanos in quantities generally not exceeding 1·5 per cent. From 3 to 68 per cent. of this is immediately available to plants.

Ætiology of Oroya Fever. Cultivation of Bartonella Bacilliformis (H. Noguchi and T. S. Battistini, *Journal of Experimental Medicine*, June 1, 1926).—A pure culture of micro-organism resembling in morphology and pathogenic action *Bartonella bacilliformis* has been obtained from blood taken during life from a case of Oroya fever which ended fatally. The blood taken at Lima and transported to New York at refrigerator temperature yielded positive cultures twenty-eight days after its withdrawal from the patient. The strain of *B. bacilliformis* thus isolated grows well on the semi-solid leptospira medium, and also on slant agar containing animal blood. The initial growth is not readily recognizable to the naked eye, but the presence of the organisms can be determined by means of the dark field microscope and by Giemsa and Gram staining methods. No growth has been obtained on the more ordinary culture media. The organism is an obligate aerobe, is Gram-negative, and under certain cultural conditions motile. All the forms which have been described as occurring in human red corpuscles may be found in the cultures, and in addition many granular and coarsely irregular forms have been met with. The inoculation of cultures *B. bacilliformis* into *Macacus rhesus* produces infection and gives rise to effects which differ with the mode of inoculation. The intravenous injection of the culture into young macaques induces a prolonged irregularly remittent fever. The organism can be cultivated from the blood over a long period, and it has been detected within the red corpuscles of the monkeys, reproducing the precise appearances observed in human cases of Oroya fever. The intradermal injection of the culture into the eyebrow of the young macaques gives rise to nodular formations rich in new blood-vessels and showing the bacilliform organism within the endothelial cells. From the experimentally induced nodules cultures of the organism are readily recovered.

Abstract.

DESTROYING ENGORGED ANOPHELES AS A MALARIA CONTROL MEASURE.[1]

By J. A. LePrince.

The value and importance of applying emergency malaria-control measures has been stressed by Fricks, Gorgas, Howard, LePrince, Orenstein, Ross and others, and again recently in the Report of the International Congress on Malaria at Rome, Italy. The field workers of the United States Public Health Service have been studying the application of malaria control measures since 1914, and in malarious localities they find the greatest prevalence among the farm-tenant classes, many of whom are relatively poor, and malaria is not infrequently a contributing cause to their poverty. If a control measure can be devised and applied that will not necessitate any investment of capital until such time as these tenants are better able physically to carry on their daily tasks, it will be in every way advantageous to them.

Although much publicity has been given to matters pertaining to malaria control, it is not uncommon for communities and even health workers to start malaria control campaigns before studying the nature of the local problem. Not infrequently those who are assigned the task of supervising the field measures have had but little previous experience, or may be unaware of special measures which were developed and applied years ago, which, if modified, might be very well suited to the conditions surrounding the new undertaking. As a result methods that are less satisfactory, more expensive, unsuited to the problem, or doomed to failure may be adopted with unfortunate results. Such procedure has a tendency to give the neighbouring public a fixed impression that all mosquito control measures are expensive and of doubtful value.

Throughout the malarious districts of this and other countries are suburban sections of rapidly growing towns, farming settlements, industrial plant villages, construction camps and other groups of homes that have been located in sections particularly favourable to propagation of malaria-bearing mosquitoes although non-anopheles producing areas may exist near by. Such errors of selection of location are even yet common, and create conditions that may require emergency mosquito control measures. It is particularly important that this subject should be better understood and more widely known by those directing the development of industries or natural resources, and even more so by those connected with the establishing of military or naval camps. Naval, military, engineering and technical schools can advantageously give this subject the attention it deserves and thereby reduce serious losses that may otherwise occur.

Temporary emergency measures are not as satisfactory as permanent mosquito eradicative measures; yet at times they are an excellent substitute and can often be made of decided importance in opening up new territory, in engineering construction operations, in colonization, in developing agricultural lands in malarial territory, and in naval and military campaigns. A large economic loss is continually going on for the lack of their application. In districts of relatively high anopheles prevalence, where construction operations or other activities are to be undertaken, labourers or settlers are attracted, and among these people may be sufficient malaria carriers to create conditions favourable to a serious outbreak of malaria. Conditions may or may not be favourable for the control of malaria carriers by means of quinine treatment. In nearly all cases, however, the people will be friendly toward any reasonable action that will reduce or destroy the mosquitoes that annoy them. Where a large portion of the new arrivals come from non-malarious territory and mix freely with the malaria carriers in the presence of anopheles, an emergency situation may arise. In very few similar situations are precautionary operations against anopheles production undertaken sufficiently far in advance. They certainly were not at the Panama Canal, nor more recently when we located our military cantonments in the most malarial sections of the south.

It is not unusual for the best plans for permanent anopheles eradicative measures sometimes to fail temporarily and thus create conditions requiring prompt application of auxiliary malaria control measures. Among such causes might be mentioned the following: (1) A reduction of working appropriations; (2) shortage of larvicides; (3) a shortage of screen; (4) a shortage of quinine; (5) a supervising official not in sympathy with anti-mosquito work; (6) a change of directing officials; (7) man-made changes of topography; (8) influx of people from highly malarious districts; (9) an unusual rainy period or season; (10) natural changes of topography; (11) sudden and unforeseen appearance of aquatic plants in quantity in bodies of water, wind-driven flotage on (tidal) fresh-water rivers, such as large rafts of eel grass, stream-borne flotage on lakes or from highlands to rivers affected by tides; (12) unexpected reduction of natural mosquito enemies due to unusual seasonal or other causes.

During the construction of the Panama Canal frequent emergency conditions arose or were unnecessarily created which are described in "Mosquito Control in Panama." We can expect similar and also new unexpected conditions and problems to arise with other species of anopheles, and they must be solved locally by sanitarians. Those who are detailed to direct anopheles control campaigns should consult all sources of information and combine the findings of others with a bountiful supply of common sense in directing malaria control operations.

The remedy for the emergency situation can often be best determined by a close study of the habits of the local anopheles, which may vary considerably with different species and in different localities. At Panama the most important of the

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malaria-carrying anopheles were the *albamanus* and *tarsimaculata*. The latter, during the dry season, rested in ground cracks in the day time. By placing small bundles of hay under the house they were induced to ignore the ground cracks and to collect in the small piles of hay. Members of the species at Gatun did not rest on the wooden beams under occupied houses as our *Anopheles quadrimaculatus* does. They would collect under certain houses in the day time but never under certain other houses near the selected ones.

A close study of the problem has shown that a knowledge of the habits common to many anopheles may be used to advantage by sanitarians in practical malaria control. The following are some of the important points to be kept in mind:—

(1) After many species of anopheles become engorged they rest on the wall or suitable shaded resting place relatively close to where they obtained their blood-meal, and it is not usual for them to fly for a considerable time after becoming engorged.

(2) Those which have digested their blood-meal and are ready for flight depart from their day time resting place (house or enclosure) either (*a*) soon after dusk, or (*b*) soon after daylight.

(3) In the screened building the anopheles, ready to depart, collect on the window screens and doors during these periods, and, with a little care and practice, practically all of them may be destroyed. While on the screens they appear to be more interested in escaping from the building than from the person who is destroying them.

(4) The recently engorged anopheles at rest on the walls of the building are relatively easy to destroy. If they are rather closely spaced, a chloroform bottle or a Griffitt catching tube may be used to advantage for collecting them; but ordinarily the common fly swatter will be found of more practical use.

(5) Light-coloured walls make the task an easier one. In relatively dark rooms a flash-lamp or other suitable artificial light (but not too bright) is an advantage in obtaining perfect results.

At the farm-tenant homes where the family has insufficient funds to protect themselves from malaria by making the home mosquito-proof, it is known that a considerable reduction in malaria transmission can be accomplished by systematically destroying the anopheles that are to be found each morning resting on the walls of the bedrooms. This is effective where no attempt has been made to screen the building.

Most of our malaria in the United States is conveyed by *Anopheles quadrimaculatus*. This mosquito very rarely bites in the full sunlight and does not like bright lights. It is a night feeder, but will at times attack man in houses in the day time. When it bites us at our homes, in most instances it rests on the walls of the room where it took its blood-meal and remains there quietly for a day. Occasionally some of them go into adjacent rooms. After taking the blood-meal this particular mosquito appears to be more sluggish and it is not as easily alarmed as are some other kinds of mosquitoes. It is relatively easy to destroy, and children, after a few trials, are soon able to find all mosquitoes resting on the walls. On rough wooden walls the resting anopheles look like wooden splinters that stand out from the flat surface. It is possible for the children in the farm-tenant homes to learn how to find and destroy every anopheles in the room, and they enjoy doing it.

If these mosquitoes on the walls are destroyed at a definite hour each morning then malaria transmission will practically be prevented in that home. There are many localities in which eradication of anopheles by drainage may not be undertaken in the near future and where the farm tenants cannot screen their homes. In such places this control method can be used to advantage.

Many persons, when bothered by pestiferous mosquitoes or when moving into a malarial district are likely to confine their precautions to the use of mosquito lotions and a mosquito bed-net. In tents and in dark bedrooms at times we find anopheles resting on these mosquito bars by preference, and careful observations indicate that a considerable number of persons can be bitten through the cotton mosquito bed-net while asleep and can be entirely unaware of the fact the following morning. This may be because the bite of some anopheles is less painful than that of other more pestiferous mosquitoes. Before a person is ready to accept or apply any health control measure suggested he is likely to want to know what results may be expected from the efforts expended.

During the building of the Panama Canal, Gorgas used the anopheles control method above-described on a large scale in the native thatch huts, at labourers' barracks, in railroad bunk cars, and in both screened and unscreened residences. The results were highly successful, the accounts of which were published.

In 1908 a temporary labourers' camp, consisting of tents, was established near the site of the present Miraflores Locks and used for four and a half months during the rainy season, when malaria transmission is most frequent. This camp was completely surrounded by extensive untreated anopheles breeding places. A labourer with a fly swatter and catching tube was employed to destroy all the anopheles he could find in the tents. Each tent was examined soon after the labourers left each morning. The malaria incidence among the labourers in these tents was thus kept down to 4 per cent. per month, or the normal rate at that time for the Canal Zone labourers sleeping in screened buildings at camps where mosquito control work was being done. No attempt was made to screen the tents in this camp, and the labourers were free to go to any other camps after dark. Some of them did go. Their night visits to other localities may have had a relation to the malaria that appeared at this camp. This malaria sick rate was less than 7 per cent. of the rate of our troops living in well-screened barracks located three miles away. At both places the malaria-conveying species of anopheles were very numerous.

Another instance of the value of daily destruction of anopheles in sleeping quarters in the same

year was at Diablo Hill, about three miles from the City of Panama. United States Marines were stationed in well-screened barracks on the hilltop and had a weekly malaria sick rate of 14 per cent. The camp of the railroad labourers was between the same hill and a prolific anopheles-producing swamp. A negro was engaged less than an hour each morning to destroy all the anopheles he could find in the bunk cars of this railroad camp. The anopheles that gained entrance to the soldiers' barracks were not destroyed. The malaria sick rate of the United States Marines was 42 times that of these railroad labourers, and the camp of the latter was at the edge of the swamp, and the screen doors of the bunk cars were kept propped open by the labourers after dusk.

Again, during the period of relocation of the Panama railroad, the jungle was being flooded by the slowly rising waters of Gatun Lake, making an excellent breeding area for anopheles. Very little was done in the matter of controlling the extensive breeding places of anopheles with which many of these temporary "relocation camps" were surrounded. The labourers' camps were located close to the water, and native villages were built close to them and contained many malaria carriers. These camps were strung out along a line of about twenty miles of right of way. At these settlements and camps a daily mosquito catch was made. The malaria incidence, even under these conditions, by means of daily destruction of engorged anopheles, was kept as low as the incidence of the Canal Zone as a whole, where mosquito production was under excellent control at many camps. It was even lower than at some of the camps in the hill country where hand catching was not used and where labourers lived in well-screened houses. Moreover, during a period of several months the anopheles in native houses and in camp cars in the lake region (Panama Railroad relocation) were all taken alive and sent to the laboratory for dissection, and no infected specimen was found, indicating that, for all practical purposes, this daily catch emergency control method was decidedly effective. All anopheles that were collected in the careful daily catches were caught before they had time to become infected.

Equally good results were obtained during the historic flight of anopheles at Gatun in 1912, when *Anopheles torsimaculata* from a hydraulic fill containing blackish water became sufficiently numerous to compel the clerical force to cover cane-seated chairs with blotters and to use paper leggings held in place by elastic bands, as protective measures. This control method was also used with considerable success at Carazol and at Miraflores, where more than 1,000 anopheles were caught in a single night in a small, properly designed, double-flare mosquito trap about 2ft. long and 18 in. high. At one time the weekly catch of anopheles that gained access to dwellings in the Canal Zone varied from 7,000 to 22,000.

Recently, at a farm home on the coast of Georgia, where the little children of the family were badly infected with malaria, listless and apparently not used to enjoying life, great excitement and interest was aroused when a play-game was made up to capture the engorged anopheles resting on the walls of the bedroom and porch. There was lively competition to see who could get the most mosquitoes, and in a short time the children were laughing and thoroughly enjoying the work. Unquestionably in future years better and more economical methods of anopheles eradication than are now employed will be devised, but in the meantime we can advantageously apply such a method as the one outlined. It is thought that its practical use and value to our farming population of malarial districts is sufficiently important to cause sanitarians to make it better known and more widely employed.

Current Literature.

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Prickly Heat (H. W. Acton).—This affection is known under several names, of which prickly heat is the commonest. It is a staphylococcal infection of the mouths of the sodden sweat ducts. These staphylococci may be derived from the skin, but more frequently from an existing seborrhœa of the scalp. The staphylococci of the scalp are strewn all over the body, either by falling from the head or through the agency of clothes or towels. Excessive perspiration causes the epithelium of the mouths of the sweat ducts to desquamate; this is brought about by excessive exercise or increase in the temperature and humidity. Rough and warm clothing tend to the extension of the disease, by causing either excessive perspiration or exfoliation of the horny layer. The staphylococcal infection is best controlled by keeping the skin dry with an antiseptic dusting powder. The treatment of the primary lesions of the scalp is to prevent the staphylococci from being scattered all over the body.

The Diagnosis of Typhoid-like Fevers, with Special Reference to Typhoid and Kala-azar (G. Shanks and G. P. Khan).—The methods for arriving at a diagnosis in patients with typhoid-like fevers are discussed, and illustrations of the difficultes are cited. Particular emphasis is laid on methods involving culture of the blood and examination of its serum reactions with special reference to cases of typhoid and kala-azar. Dreyer's standard method of carrying out the agglutination reaction has been found of great value. It eliminates unreliable results, and, while requiring care in the preparation of bacterial emulsions and the use of special apparatus, in an institution where many agglutinations have to be carried out it is more expeditious than other methods. The routine complete examination of cases of typhoid-like fever has brought to light the occurrences of some interesting associations between typhoid and kala-azar. In two of the five cases in which an attack of kala-azar supervened after typhoid it was noted that the agglutinins for *Bacillus typhosus* had disappeared within a short

interval. While in certain cases a primary *Leishmania donovani* infection may have an onset clinically resembling that of typhoid fever, followed by an interval and then followed by a further febrile illness, in others there may be a primary true typhoid infection succeeded (after a lapse) by kala-azar. In cases where the initial febrile attack is diagnosed as typhoid fever by agglutination tests a curve should be sought for, as a low titre might be the residue of some previous infection. A case diagnosed by blood-culture as typhoid fever was followed by typical kala-azar which yielded to treatment with antimony. The agglutinins for *B. typhosus* disappeared when the kala-azar supervened. Another case was diagnosed as kala-azar by the aldehyde test, and while undergoing treatment the patient developed typhoid fever, as shown by a positive blood-culture.

Tuberculosis in Bengal (E. Muir).—Tuberculosis or the " white plague " is perhaps the most fatal disease of large towns. Reports for 1921-1924 show that the number of cases are rapidly increasing, especially in Calcutta and Bengal. The death-rate of females between the ages of 15 and 20 is appalling, and if the present rate is kept up it will mean that on an average one out of every ten in Calcutta will die of this terrible plague. The chief reasons for the prevalency of this disease in India are bad housing, careless spitting, poverty, under-feeding and early marriage, and the *purdah* system. Bengal has no special sanatorium for tuberculosis at present, although a few hospitals have special tuberculosis wards.

Seven-day Dengue in Lucknow (H. Stott and V. Mangalik).—An epidemic of seven-day dengue fever occurred in Lucknow during September, October and November, 1925. It started at the Lady Kinnaird Hospital among the nurses, and was followed by an outbreak among the nurses and students of King George's Hospital. There were a considerable number of cases in the city. This malady, however, is not infrequent at Lucknow. Epidemics usually occur after the rains, somewhat later perhaps than the early cases of malaria. The incidence of secondary febrile rises, of rashes and of joint pains varies in individual outbreaks and in individual cases in the same outbreak, but the general clinical picture of the whole outbreak is a clear-cut one. Three-day dengue attacks in the outbreaks were not common, and certainly not so common as in similar outbreaks of dengue in Madras, Bombay, at sea, and in Mesopotamia. Perhaps this was partly due to the fact that most observed cases were nurses and students, amongst whom temperature records were available from the earliest onset of the fever. Mosquitoes of all varieties and sandflies were observed during the outbreak, but sandflies were few in number. For this reason it is perhaps more likely that the outbreak was one of mosquito-dengue than of sandfly-dengue, but it is impossible to state this with any certainty.

Notes on the Treatment of Benign Tertian malaria with Cinchona Febrifuge (O. A. R. Berkeley-Hill).—Conditions at the Ranchi European Mental Hospital are suitable for experimental investigation of the value of any suggested standard treatment for malaria. There is little indigenous malaria in Kanke and chances of reinfection by natural channels are small. Full laboratory facilities are available for confirming the diagnosis; the patients are under careful observation and control; whilst they can be observed for months together after the cessation of treatment. In such circumstances, 43 patients suffering from benign tertian malaria were treated in 1924-1925 at Ranchi with the standard one-month's treatment with cinchona febrifuge advocated by Acton and Knowles (1924). Only six of these patients relapsed, giving a cure rate of 86 per cent., and a relapse rate of 14 per cent. These results are very much better than those usually obtained in general hospital practice in India. Yet certain patients cannot tolerate cinchona febrifuge, whilst in others continuous administration of the prescription given tends to cause diarrhœa. A modified formula is accordingly given which may prove to be more suitable.

Bilivaccin-Cholera versus Commercial Cholera Vaccine (G. C. Maitra).—Bilivaccines were introduced into the Calcutta School of Tropical Medicine about a year ago. It is asserted that they confer lasting immunity against cholera, dysentery and other intestinal diseases when taken by mouth. Experiments were carried out and it was seen that the immunizing properties of Merck's cholera vaccine (prepared by Merck and Co., of Darmstadt) compared favourably with those of vaccines prepared locally from fresh cholera strains. There was, however, a considerable discrepancy found between the number of bacteria stated to be contained in Merck's vaccine and that calculated to be present in it by Brown's method. Although a comparative study of the results obtained by using the two preparations, the bilivaccine and Merck's cholera vaccine, apparently shows that the former protected more efficiently than the latter, yet no general conclusions can be made on this point for the comparatively poor results of Merck's vaccine may have been due to its low bacterial count.

A Trial of Oral Vaccination against Bacillary Dysentery in Indian Jails (G. C. Maitra and J. B. Basu).—Preliminary experiments have been made in India on rabbits with dysentery and cholera " Bilivaccines "; and as the results were encouraging, oral vaccination against dysentery was tried in certain selected jails in Bengal and Madras Presidencies. The two preparations used were (1) Bili-vaccine-Shiga, consisting mainly of compressed tablets of desiccated bacterial bodies (formula of Prof. Besredka); (2) a mixed and sterilized emulsion of dysentery bacilli. It would appear that the percentage incidence of dysentery among the vaccinated was appreciably reduced in both cases, but the reduction was more marked when bilivaccine tablets were used for immunization. These results call for a wide application of the same principle in fighting cholera which is a much more fatal disease and causes greater havoc in India than do the dysenteries of bacillary origin.

Original Communications.

INFECTIOUS JAUNDICE IN THE SUDAN.

By N. T. WHITEHEAD, M.C., M.B., Major R.A.M.C.,
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AND
H. A. CROUCH, M.C., M.R.C.S., L.R.C.P.,
Sudan Medical Service.

THE following are notes on three separate outbreaks of jaundice occurring in the Sudan during the years 1922-25.

The outbreaks bear no relation one to the other, either in character or locality, nor do they accurately conform to any one type of the disease. Unfortunately, lack of laboratory facilities rendered accurate diagnosis impossible in two of the outbreaks. In the Port Sudan epidemic laboratory work was undertaken to investigate the causation and origin of the outbreak, results of which are stated later.

The authors, while realizing investigation is thus incomplete, consider the incidence and clinical picture to be of some interest.

PORT SUDAN EPIDEMIC.

Forty-seven cases occurred during the months of January, February and March, 1922. The chief *symptoms* in these attacks were jaundice—headache—pain in the epigastrium—some vomiting after food—slight fever for the first day or two (according to the patients' statements).

Signs.

Temperature.—The majority of those cases admitted to hospital showed no rise of temperature after admission, and in no case did the temperature rise above 100 or last more than three days.

Urine.—The urine of the greater number of cases was examined for albumin with negative results.

Jaundice.—Disappeared five to six days after date of onset.

The average stay in hospital was four days. None of the cases seemed to have suffered from weakness or debility after their discharge.

Epidemiology.

None of the cases gave any very definite indication that the disease was a contagious one, nor did they seem to have much connection with each other.

Most of the cases occurred singly and came from both the clean and sanitary houses of the town and the insanitary shanties of the surrounding villages.

The following set of cases show a superficial relationship, but on further investigation the connection is not of much account.

Amongst a set of nine policemen three men fell sick on the following days, February 8, 12 and 16.

The first two men lived, slept and ate in the same room as six of their comrades, none of whom contracted the disease, the third man, who was in charge of the others, had a room to himself and took his meals in the market place.

The cases that came to hospital were nursed in the general ward and no case of jaundice amongst the other patients was reported.

No European subject and no native woman ever contracted the disease.

Rats and flies were prevalent, more especially in the villages and in the market place of the town. There were no mosquitoes in or around Port Sudan.

There is one point in connection with the local customs that should be borne in mind, and this is that a large proportion of the native male population have their meals in the market place. No particulars were obtained at the time as to whether there was any connection between the cases and the various eating houses in the market, but it is conceivable that the outbreak might have been caused by food sold in the market which had been infected by some intestinal organism of somewhat low virulence.

The freedom of the women from the disease and the fact that the infection, though widespread, affected only individuals and not families seems to support the theory that the source of infection was the market rather than the home.

The *laboratory work* undertaken aimed at investigating the following possibilities:—

(1) *A Typhoid or Paratyphoid Infection.*—The blood of the last two cases was inoculated into broth, but both bloods proved to be sterile after forty-eight hours.

The fæces of seven cases were plated on MacConkey; no non-lactose fermenting organisms were grown. The urines of six cases were inoculated into broth, but again no organisms were grown.

(2) *Spirochætal Infective Jaundice.*—The centrifuged deposit of 20 c.c. of urine was injected intraperitoneally into guinea-pigs. This test was performed with three different cases, but none of the guinea-pigs were affected in any way.

The blood from another case was injected intraperitoneally into a guinea-pig, but this gave no result either. The urine was collected, centrifuged and thin smears made of all the eight cases under investigation. Two of these cases showed a fair number of spirochætes. Blood-counts were performed in each of the eight cases, and all showed a leucopenia and a relative lymphocytosis.

Blood-films showed no parasites in any of the cases.

Conclusions.

Clinically the cases were cases of camp jaundice and differed from spirochætal infective jaundice in the following points:—

(1) The mildness of the attacks.
(2) The absence of liver enlargement.
(3) The absence of albuminuria.
(4) The absence of pathogenicity of the urine towards guinea-pigs.
(5) The absence of hæmorrhagic symptoms.

Whether the spirochætes found in the urine were the causal organism of the disease or not, they were not pathogenic to guinea-pigs, and have, there-

fore, been considered as not being identical with the spirochæte of infective jaundice.

KASSALA RAILWAY CONSTRUCTION.

This outbreak occurred in an isolated working party of a British inspector and forty Berberines. The party lived under canvas in the desert alongside the railway, far removed from any habitation.

Ten cases of jaundice were reported during the months of February and March, 1924, and of these the British inspector was one of the earliest to come under treatment.

Symptoms.

Premonitory.—Fever, headache, lassitude, loss of appetite, nausea, constipation or diarrhœa.

Jaundice.—Present in all cases. In most cases became obvious on the third day and continued for nine to ten days.

Pain was complained of in four cases, the remainder experienced a sense of discomfort in the epigastrium.

Vomiting occurred in half the cases.

Signs.

Temperature at onset 100 to 101. Remained at 99 to 100 for seven to eight days.

Urine.—The urine in all cases was examined for albumin but proved negative.

Liver.—The liver was definitely enlarged in three of the cases.

Course

All cases were mild and recovery was complete in two to three weeks. One case, however, relapsed on return to work, and all the above signs and symptoms again became evident. In this instance the liver was not enlarged, but the patient developed ascites with cardiac dilatation and died.

Conclusion.

Here again, and even more so than in the Port Sudan epidemic, it seems certain that these cases were in some way connected. As stated above, local conditions made further investigation impracticable, but in view of the fact that some of the cases commenced with an attack of diarrhœa, it would seem probable that infection took place through the alimentary tract. Four to five men slept and fed in each tent, and cases were equally distributed. The British inspector and his servants lived alone and a little apart from the camp.

Food and water were brought up by train and were the same as for the main railhead camp, where no cases were reported. The camp was moved ten miles ahead every seven days.

Flies were very prevalent, but not more so than elsewhere on the line. There were no mosquitoes or any other pests.

Clinically the cases resemble camp jaundice, or possibly a mild paratyphoid infection.

MALAKAL.

During the months March-May, 1925, five cases of jaundice were admitted to Malakal Hospital. Of these, two came from the local village, two from Tonga, and one from Fungak. The latter places are some seventy miles up the river.

The cases were not related one to the other, nor was there any history of malaria, diarrhœa or syphilis.

Prodromata.

General lassitude, anorexia, headache; in one case general muscular pains.

Symptoms.

Fever.—Present in all cases at onset.

Headache.—Severe in two cases.

Pain.—All complained of pain in the epigastrium and right hypochondrium.

Vomiting.—Occurred in all cases.

Signs.

Temperature.—Onset on third day, 100-103. Duration, seven to ten days. Fluctuating.

Jaundice.—Appeared with the fever and lasted ten to twelve days.

Bowels.—Three cases had marked diarrhœa; none were constipated.

Liver.—Enlarged one finger's breadth in three cases.

Lungs.—Two cases developed bronchitis on the fifth day.

Heart.—Cardiac dilatation occurred in one case.

Urine.—There were traces of albumin in three of the five urines examined.

Complications.

One developed tympanitis, two bronchitis, one general myositis and one cardiac enlargement. The latter died.

Conclusion.

From the above it will be seen that these cases were of a more severe type than those of the other two epidemics, but they do not appear to be connected one with another in any way, nor is there any evidence of their having a common origin.

It may be remarked that all three epidemics occurred at the same time in the year, that is at the beginning of the hot weather, when flies are particularly prevalent.

BRONCHO-SPIROCHÆTOSIS.

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AT the kind request of many medical men residing in different countries I propose, in this paper, to give a brief general account of broncho-spirochætosis.

DEFINITION.

Broncho-spirochætosis, *sensu lato*, is a term used to cover all bronchial and broncho-pulmonary conditions associated with the presence of a large number of spirochætes in the sputum, which are, in all probability, the causative agents.

SYNONYMS.

Pulmonary spirochætosis, broncho-spirochætosis. Castellani's bronchitis (Galli-Valerio), bronchite sanglante de Castellani (Violle).

History.

The history of broncho-spirochætosis is, briefly, the following: In 1904, in Ceylon, two natives came to consult me for recurrent hæmoptysis. I kept them under observation for many months, but never succeeded in finding the tuberculosis bacillus. The sputum, instead of the bacillus of tuberculosis, contained an enormous number of spirochætes, in fact, in the bloody portions of the expectoration these parasites were practically the only organisms present. The spirochætes almost completely disappeared during periods of quiescence, to reappear again in large numbers every time the symptoms became acute. I came, therefore, to the conclusion that there was probably a form of hæmorrhagic bronchitis of spirochætic origin. Later I came across other cases. My work was confirmed by Branch in 1907 in the West Indies, and by Jackson in 1908, and in the Philippine Islands. In 1909 Waters described numerous cases of the disease occurring in India, and Phalen and Kilbourne described a case in the Philippine Islands where, in 1911, Chamberlain recorded two more cases.

In 1913 Chalmers and O'Farrell carried out an investigation on the malady in the Sudan, and succeeded in reproducing it in a monkey. In 1914 Taylor investigated the condition in Uganda. In 1915 Fantham published a classical paper on *Spirochæta bronchialis*, studying it completely from a morphological point of view; he described its granular stage and the intracellular forms of the parasite.

In the same year Macfie reported cases from West Africa, and Galli-Valerio recorded several interesting cases of the malady in Switzerland, and Lurie and myself one in Serbia. In 1917, Violle first noted the affection in France, and a number of cases were reported by Beau, Dide and Ribereau, by Netter, Dalimier, Barbary, and others. In 1919 Farah described several cases in Egypt, and Alcock a case occurring in a British soldier, in Northern Italy. Villa and Corvetto and, more recently, many other observers have recorded cases in South America; Clark and Facio in Central America; Mendelson in Siam; Levy, Bloedorn and Houghton and many other observers in North America; Broughton-Alcock and Browne in England, and Iaconó, Trocello, Franchini and others in Italy. An interesting communication on broncho-spirochætosis in China has been published by Faust; Mouchet and Van Nitsen have found the disease in Katanga, and De Mello and De Andreds have reported cases from Portugal. Special mention must also be made of the very complete paper by Farah in the Journal of Tropical Medicine and Hygiene, April 2, 1923. The important work by Johns and Maes must also be mentioned.

Geographical Distribution.

The disease has a cosmopolitan distribution, but it is apparently more common in certain parts of the tropics and subtropics than in the temperate zone. It has been reported from practically every country in the world and during recent years numbers of cases have been placed on record in the United States, and a few in England.

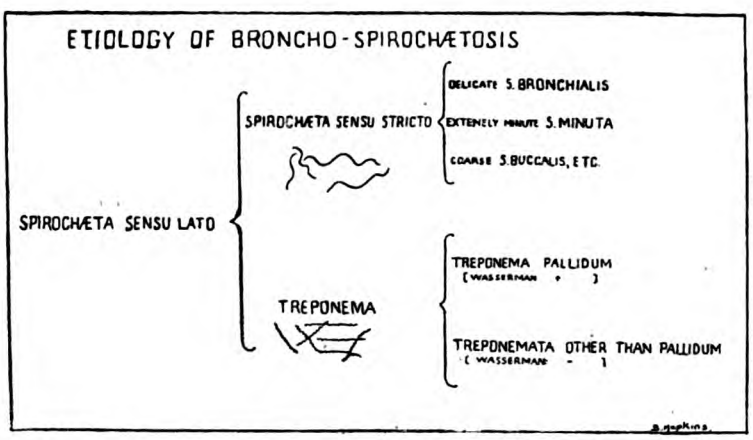


Fig. 1.

Ætiology.

The spirochætes found, as I noted in my first publications, may be of very different morphological appearances. In the present state of our knowledge, I think that the following classification might be accepted for practical purposes by the clinician:—

(*a*) The spirochætal organisms present a few spirals or coils of different sizes: *Spirochæta sensu stricto*.

(*b*) The spirochætal organisms present numerous small equal undulations close together: *Treponema*.

The first group may be divided into two subgroups:—

(1) The spirochæte is very delicate—*Spirochæta bronchialis*, *Spirochæta minuta*.

(2) The spirochæte is of coarser appearance—*Spirochæta buccalis*, *Spirochæta vincenti*, &c.

The second group may also be divided into two subgroups:—

(1) *Treponema pallidum* (Wassermann positive).

(2) Treponemata other than pallidum (Wassermann negative).

Spirochæta bronchialis.—With regard to the spirochæte which I called *bronchialis* in 1907, it has been thoroughly studied by the distinguished protozoologist, Professor Fantham.

The spirochæte is extremely polymorphic; its length varies between 3 and 30 microns, its breadth between two-tenths and six-tenths of a micron. Fantham noted two principal types: those having a length of 7 to 10 microns and those having a length between 14 and 16 microns; he believes that the former originate by a transverse division from the latter.

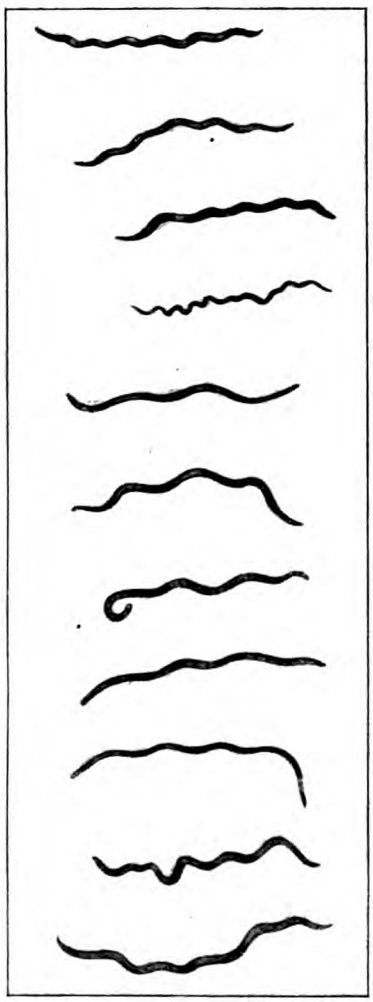


FIG. 2.
Various types of *S. bronchialis* (after Fantham).

Spirochæta bronchialis, according to Fantham, Chalmers and O'Farrell, differs from the common mouth spirochætes in the following points: (1) It is more actively motile. (2) It dies very quickly in fresh preparations of sputum. (3) It is stained with more difficulty. (4) According to Fantham, there is an intracellular stage, which is absent in the common oral parasites.

Spirochæta Minuta.—This is an extremely minute spirochæte which I found in certain cases of broncho-spirochætosis following spirochætic rhino-pharyngitis. It is very delicate, more delicate than *S. bronchialis* and most organisms present only one or two undulations. It can be put in evidence by the ultra-microscope, or by staining with various modifications of Romanowsky, the best for this particular spirochæte being apparently Jenner's modification. Silver methods of staining (especially Fontana-Tribondeau's technique) give good results. In preparations stained with Romanowsky, or other modifications of this method, the

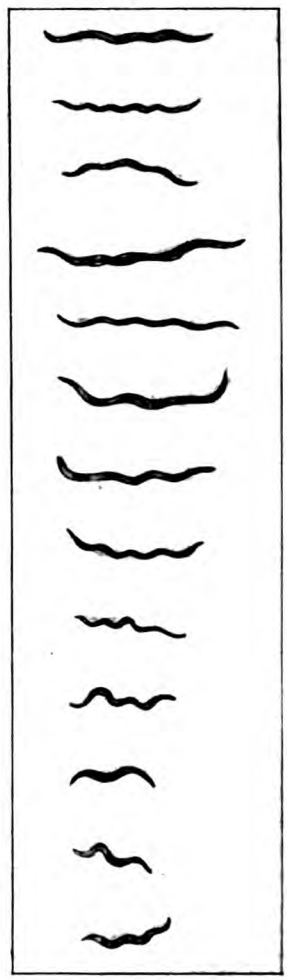


FIG. 3.
Various types of *S. bronchialis* (after Fantham).

organism often takes a pinkish-red or purplish tinge. The length of the organism varies from three to six, ten, or twelve or more microns. The beginner should be careful not to mistake for spirochætes undulating fibrin threads, particles of detached ciliated epithelium and detached cilia.

Spirochæta buccalis.—This term covers probably several species which are generally coarser than *S. bronchialis*. With regard to *S. vincenti*, a descrip-

tion of this organism was not given by Blanchard when he named this parasite, and Professor Fantham believes that this term cannot stand according to the rules of nomenclature

Treponemata.—Treponema pallidum may localize itself to the lungs and there is no doubt that cases of syphilitic broncho-pulmonary spirochætosis occur. I saw a typical case at Taranto some years ago which had first been diagnosed as pulmonary tuberculosis. In such cases Wassermann is positive. Other treponemata may also apparently cause broncho-spirochætosis, especially the purulent type.

In the cases due to treponemata other than *T. pallidum* Wassermann is negative.

Organisms found in Association with the Spirochætes.

It is seldom that the spirochæte is found alone. It is usually accompanied by various bacteria: streptococci, pneumococci and, also at times bacilli of the fusiform type and an organism which Chalmers and I used to call *macro-vibrio*, are present. The fusiform bacillus is a long fusiform straight bacillus, the macro-vibrio of Chalmers and myself and Kline is curved, comma-like, at times banana-like, of large size, very motile, possessing one or several cilia or flagella.

Predisposing Causes.

In some types of broncho-spirochætosis a chill often acts as a predisposing cause.

Method of Infection.

According to Chalmers and others, in some types of broncho-spirochætosis infection takes place from affected to healthy persons, the spray exhaled in coughing being contaminated with the spirochætes or with the resistant coccoid bodies. According to other authorities, *Spirochæta bronchialis* and the other spirochætes found in cases of broncho-spirochætosis are always present in the mouth; a chill, an operation, &c., may decrease the organic resistance of the carrier and increase the virulence of the organism in a way somewhat similar to what is the case of pneumococcus and other micro-organisms.

Experimental Reproduction.

Chalmers and O'Farrell reproduced the Sudan type of the disease in monkeys. Attempts to infect guinea-pigs always failed. The putrid type of the condition has been experimentally reproduced by several observers (Davis, Kline and Blakenhorn) in rabbits by intrabronchial injection of material from dental caries containing innumerable spirochætes and also fusiform bacilli and the macro-vibrios.

Morbid Anatomy and Histopathology.

The morbid anatomy and histopathology of broncho-spirochætosis have not yet been completely investigated, but important work on the subject has been carried out by Johns, Duval, Davis, Franchini, Kline and others. I have seen three autopsies (of the purulent type) and in all of them there was a patchy consolidation of both lungs, and in two of them there were several small foci of necrosis the size of a small pea to a cherry. The cavities varied in size up to one centimetre in diameter. The mucosa of the bronchi were swollen and injected, but no bronchiectasiæ were present. Some of the peribronchial glands were enlarged, but in none was there any caseation. The microscopical examination of stained sections showed well-marked infiltration and, when the Levaditi method was used, large numbers of spirochætes were seen. It must be noted, however, that in addition to spirochætes, other organisms were present; cocci, streptococci and organisms of the macro-vibrio type. (Fig. 4, p. 364.)

Symptomatology.

Several clinical types of the disease may be recognized, both acute and chronic.

Acute broncho-spirochætosis.—Two varieties have been described; the acute bronchial or influenzal variety and the pneumonic variety.

Chronic broncho-spirochætosis.—The following principal varieties are now generally accepted: (1) with muco-hæmorrhagic or muco-purulent hæmorrhagic sputum; (2) with purulent expectoration; (3) with putrid expectoration. Two other varieties may be mentioned; the asthmatic variety which has been studied principally by Farah, and a variety following rhino-pharyngitis spirochætica as described by me. (Fig. 5, p. 364.)

Acute broncho-spirochætosis.—This type at times resembles influenza. The onset is often abrupt, the patient feeling chilly and complaining of rheumatoid pains all over the body and developing fever which generally is not very high. The fever may last from two or three to ten or twelve days. The patient coughs a great deal and expectoration is scanty, muco-purulent, very seldom containing traces of blood. In most cases the general condition of the patient is hardly affected, in others there is great prostration. Occasionally the *pneumonic type* may be observed in which signs—generally not very typical—of lobar pneumonia are present, but this condition usually does not resolve on the seventh day by crisis and the patient is usually discharged later from the hospital as a case of unresolved pneumonia.

Chronic forms of broncho-spirochætosis—muco-purulent hæmorrhagic type. The onset is often quite insidious and slow; the patient has a chronic cough which is at times more severe in the morning. The expectoration is mucous or muco-purulent, containing now and then—in some cases constantly—blood. Sometimes genuine attacks of hæmoptysis occur, one or two teaspoonfuls or more of blood being brought up. In some cases there is no fever, in others a serotine hectic-like fever may be present. Occasionally the rise in the temperature takes place in the morning and not in the evening. In other cases the temperature chart is most irregular. The physical examination of the chest may reveal little or nothing, but in certain cases

definite signs of patchy consolidation are present. The general condition of the patient may remain fairly good for a long time, though a certain degree of anæmia is often present. In a few cases severe rapid wasting takes place. The course of this type of the disease may be very prolonged

X-RAY EXAMINATION.

In mild cases the X-ray examination shows little or nothing. In some severe cases the picture may be suggestive of tuberculosis. It may show mottling areas of patchy infiltration and diffuse peribronchial thickening.

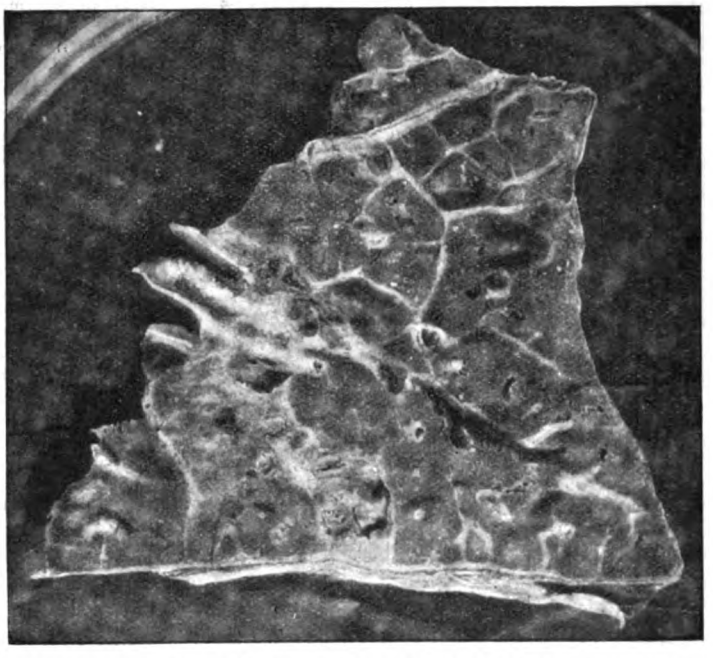


FIG. 4.—Lung in Broncho-spirochætosis of the Purulent Type. Note thickening of bronchial walls, generalized consolidation, and necrotic foci.

(*Courtesy of Dr. E. M. Johns.*)

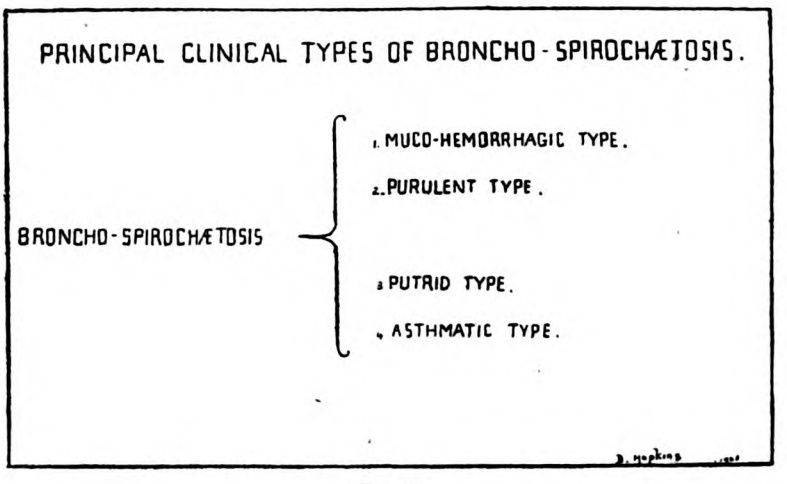


FIG. 5.

with periods of great improvement and even apparent cure. The two original cases I studied in Ceylon in 1904 were still alive when I left the Island in 1915. Cases in which blood is always absent in the sputum have been described, the sputum being mucous or muco-purulent.

Purulent Type.—In this type the patient has often a high intermittent fever and coughs up a very large amount of purulent expectoration, occasionally mixed with blood. In these cases bronchiectasiæ are often suspected, but in my experience they are not common, and no true

vomica occurs. Fever is often present and may be remittent or intermittent or very irregular. It is interesting to note that in a certain number of cases of the purulent type, the spiral organisms present are of the treponema type, and not of the spirochætic type.

Putrid Type.—The symptoms are very similar to those seen in the purulent type, but the expectoration has a very offensive odour.

Asthmatic Type.—In the asthmatic variety to which, as I have already said, Farah has paid much attention, the patient shows signs of chronic bronchitis and now and then has an attack of typical asthma.

Broncho-spirochætosis following Spirochætic Rhino-pharyngitis.—Some years ago I described rhinitis spirochætica or rhino-pharyngitis spirochætica which clinically can hardly be distinguished from an ordinary attack of coryza. In some cases, after the coryzal symptoms have disappeared or during the coryzal period, bronchitis develops with muco-purulent expectoration containing a very large number of spirochætes identical with those found in the pharynx and nose. The spirochæte in most cases of this type is extremely delicate, and for that reason I gave it the name of *Spirochæta minuta.*

Illustrative Cases of Broncho-spirochætosis.—To avoid personal equation I will report a case thoroughly investigated by Bloedorn and Houghton and published in the *Journal of the American Medical Association*, volume 76, also a case described by Iacono in the JOURNAL OF TROPICAL MEDICINE AND HYGIENE, March, 1920.

CASE 1 (Bloedorn and Houghton).—A white man aged 18, single, was admitted to the hospital complaining of headache, pains in the back and shoulders, weakness, cough and expectoration of blood-streaked mucus. Temperature 103, pulse 96, respiration 20. Teeth in good condition, no exudate on tonsils. Heart negative. Examination of the lungs disclosed only a few scattered râles at both bases, no impairment of resonance.

Clinical Course.—The patient continued to have fever with temperature varying from 100 to 102 in the morning, and 103 to 104·3 in the evening. Profuse nightsweats occurred with great regularity, and the patient during the first three weeks of his illness lost 20 lb.

There was a slight cough and rather free expectoration of a thin, muco-purulent, blood-streaked sputum. The prostration during the course of the disease was not marked, and the patient stated that he felt fairly well, but weak. The case resembled so strongly, in its clinical course, a pulmonary tuberculosis, that every effort was made to confirm such a diagnosis. The laboratory findings, Roentgen ray findings and physical examination, however, failed to demonstrate the existence of such an infection. Wassermann and Noguchi negative. During the course of the repeated sputum examinations it was noticed that, while the sputum was negative for tubercle bacilli, there were constantly present a large number of spirochætes.

The presence of these organisms was at first not regarded as significant, and it was only after repeated attempts to establish a definite diagnosis in this case that their presence was regarded seriously. Their constant presence in the sputum after the teeth had been cleansed and the throat cleared with a mild antiseptic gargle, together with the absence of a lesion of the tonsils or pharynx which account for their presence, appeared significant and strongly suggested the diagnosis of "bronchial spirochætosis."

It was decided to try the effect of an arsenical spirochæticide, and on the 20th day 0·6 grm. of neo-arsphenamin was given intravenously, and on the 21st and 22nd days the temperature again rose to 101 in the evening. On the 24th day 0·5 grm. of neo-arsphenamin was given intravenously, following which injections of 0·9 grm. of neo-arsphenamin were given at intervals of one week, although the patient had shown no rise of temperature in the meantime, and was steadily improving. Following the injections of neo-arsphenamin the improvement in the patient was striking. The prompt termination of the fever, the rapid decrease in the number of spirochætes and their ultimate complete disappearance from the sputum, the prompt cessation of the cough, and the disappearance of the blood from the expectoration, which itself became almost negligible in quantity, leave little room for doubt regarding the efficacy of these injections.

Two months following the onset of the disease the patient had regained his loss of 20 lb., had been up and about for several weeks, and was able to resume his original duties. Before discharge from the hospital he was given an injection of 10 mg. of tuberculin, following which he showed no reaction.

CASE 2 (Iacono).—Miss E. B. No previous disease of importance. Present illness began eleven days before I saw her, with general malaise, rheumatoid pains all over the body, and dry cough. The fever remained high and continued for several days, then it dropped in the morning and assumed a serotine type. Rather suspicious subcrepitant râles were found upon physical examination of the chest, in the left apex, and this fact, together with the serotine fever and sputum tinged with blood, led the family doctor to suspect tuberculosis of the lungs. When I was called in the patient was very pale and feeling very weak; upon examination of the chest, no zones of fullness were found. Moist and dry râles were present all over, but no crepitant ones. Pulse 90, pressure rather high. Heart normal. As regards the abdominal organs, the spleen was not enlarged, liver just palpable. Urine contained a trace of albumin, and there was a slight increase in the phosphates and indican. Blood: red blood-corpuscles, 4,000,000 per cm.; leucocytes, 9,000; hæmoglobin, 70 (Fleischl). As to the leucocytic formula, there was an increase in the eosinophiles and lymphocytes. No malaria parasites and no spirochætes were found. Examination of the sputum for tubercle bacilli negative. Several glucose-agar tubes were inoculated, but no fungus was grown. The microscopical examination of films from the sputum stained with Giemsa revealed presence of a large number of spirochætes of variable lengths, 5 to 20 microns, and with three to six undulations. In fresh preparations examined with the ultra-microscope numerous very motile spirochætes were seen. I made a diagnosis of broncho-spirochætosis and prescribed the mixture recommended by Castellani, the formula of which is: Tartar emetic, gr. iii; syr. tolu, ʒi; aq. chlorof., ad ʒiii; one teaspoonful in water every two hours. The patient rapidly improved and finally recovered.

MIXED INFECTIONS.

Cases of mixed infections, tuberculosis and spirochætosis, bronchomycosis and spirochætosis, are occasionally met with. It may be mentioned here that Breton and others believe that when in a tubercular patient, hæmoptysis takes place, the hæmorrhagic sputum is caused not by the bacillus of tuberculosis but by a spirochætic infection which has become engrafted on the tubercular condition. Breton is of opinion that this spirochæte differs from *S. bronchialis* and all other spirochætes.

DIAGNOSIS.

This is based on microscopic examination of the expectoration collected after rinsing the mouth and gargling with sterile water. It is essential to carry

out the examination on fresh sputum, using both the dark ground illumination and staining with one of the modifications of the Romanowsky method, or the nitrate of silver staining method such as the Fontana-Tribondeau, may be employed. The sputum, especially the hæmorrhagic part of it, teems with spirochætes, while bacteria are extremely few. The spirochætes greatly decrease in number or completely disappear when the bronchial condition improves. With regard to the diagnosis of the principal clinical types of broncho-spirochætosis, viz., hæmorrhagic, purulent, putrid, this is based on the appearance and character of the sputum; in the first variety the predominant symptom is blood in the sputum; in the second pus; in the third the putrid odour.

Broncho-spirochætosis *sensu lato* covers also a chronic broncho-pulmonary condition of syphilitic origin, with hæmorrhagic sputum, the ætiological agent being *Treponema pallidum*. In these cases Wassermann is positive while in ordinary cases of broncho-spirochætosis, including those caused by treponemata other than *T. pallidum*, this test is negative.

Differential diagnosis.—The condition has often been confused with pulmonary tuberculosis, but the examination of the sputum for the tuberculosis bacillus will be negative and animal inoculations will remain without any effect. The ophthalmo- and cuti-reactions are negative in a great majority of cases. Occasionally, however, cases of mixed infection of tuberculosis and spirochætosis occur. The affection is differentiated from bronchomycosis by the absence of fungi. Cases of double infection, e.g., broncho-spirochætosis and bronchomycosis may at times be observed, though rarely. Spirochætosis is easily distinguished from endemic hæmoptysis by the examination of the sputum which will show absence of the ova of *Paragonimus ringeri* Cobbold, and from amœbic bronchitis by the absence of amœbæ.

Prognosis.

The prognosis, except in the very severe cases of the purulent and putrid types, is favourable *quoad vitam*, but the disease runs a very chronic course, and, although periods of great improvement may take place, a true spontaneous cure is exceedingly rare.

Treatment.

Three drugs have been found useful in broncho-spirochætosis by myself and others; arsenic, tartar emetic, potassium iodide. In several cases, especially of the purulent and putrid type, salvarsan may be given intravenously in 0·3 grm. and 0·5 grm. doses once or twice a week.

The beneficial effect of salvarsan and neosalvarsan has been emphasized by Galli-Valerio, Bloedorn and Houghton and many other observers. When the patient objects to intravenous therapy, stovarsol may be given by the mouth, two or three tablets daily for a period of ten to fifteen days. Potassium iodide is useful in some cases, especially those with scanty expectoration and a tendency to asthma. Iodine-oil preparations, such as lipiodol, given by intramuscular injection are much more efficacious than potassium iodide mixtures as observed by Farah. Of lipiodol a course of twelve injections (1 c.c. each) may be given, to be repeated after an interval of two or three weeks. The injection of lipiodol and similar preparations should be given deep into the gluteal muscles. In *mild cases* the oral administration of stovarsol will be found very useful and also mixtures containing tartar emetic alone or associated with arsenic; in a few cases sulphur seems to have a beneficial action. The following formulæ may be found useful:—

1. Tartar emetic ... ... gr. ii.
   Syr. tolu. ... ... ʒ i.
   Aq. chlorof. ad. ... ... ʒ iii.
   1 teaspoonful in water every two hours.

2. Tartar emetic .. .. gr. v.
   Sodii bi-carbonate ... ... gr. xxx.
   Glycerine ... ... ʒ iii.
   Aq. chlorof. ... ... ʒ i.
   Aq ad. ... ... ʒ iii.
   Sig. 1 teaspoonful t.d. well diluted in water.

3. Liq. arsenicalis . . .. ♏ xxiv.
   Tartar emetic ... ... gr. ii.
   Codein ... ... gr. ii.
   Glycerine ... ... ʒ i.
   Syr. tolu. ... ... ʒ i.
   Aq. chlorof. ad. ... ... ʒ vi.
   1 tablespoonful t.d. well diluted in water.

4. Tartar emetic ... ... gr. ¼ to ½.
   Sodii bi-carbonate ... ... gr. x.
   Glycerine ... ... ʒ ii.
   Aq. ad. ... ... ʒ iii.
   Sig. ʒi t.d.

5. Tartar emetic ... ... gr. 2 to 3.
   Codein ... ... gr. 2 to 3.
   Syr. tolu. ... ... ʒ i.
   Aq. chlorof. ad. ... ... ʒ vi.
   1 teaspoonful t.d. well diluted in water.

6. Tartar emetic ... ... gr. ½ to i.
   Liquor arsenicalis ... ... ♏ 2 to 3.
   Codein ... ... gr. ½.
   Glycerine ... ... ʒ i.
   Syr. tolu. ... ... ʒ i.
   Aq. chlorof. ad. ... ... ʒ i.
   Sig. ʒi t.d.

7. Tartar emetic ... ... gr. 2 to 3.
   Potass. iodide ... ... ʒ i.
   Sodii bi-carbonate ... ... ʒ ii.
   Glycerine ... ... ʒ i.
   Syr. tolu. ... ... ʒ i.
   Aq. chlorof. ad. ... ... ʒ vi.
   1 tablespoonful t.d. well diluted in water.

8. Codein ... ... gr. $\frac{1}{12}$.
   Saiodin ... ... gr. v. to xv.
   Ft. cachet ... ...
   1 cachet four times daily.

9. Sulphur ... ... gr. iii.
   Pul. ipecac. co. ... ... gr. ½.
   Guaiacol carb. (Duotal) ... ... gr. x.
   Sodii benzoat. ... ... gr. x.
   Fiat pulv. ... ...
   1 powder t.d.

Prophylaxis.—As some of the spirochætes causing broncho-spirochætosis are probably always present in the mouth, mouth hygiene is of great importance and the teeth should be kept in good condition.

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The Serological Classification of Hæmolytic Streptococci obtained from Cases of Scarlet Fever (J. Smith, *Journal of Hygiene*, July, 1926).—Hæmolytic streptococci have been obtained from throat cultures of 92 per cent. of cases of scarlet fever in the first two days of the disease. Strains from 210 cases were found to belong to two main serological types, Type I strains being obtained from 119 cases and Type II strains from 57 cases. Strains obtained from cases occurring in members of the same family were found to be mainly of the same serological type. Strains obtained from cases in small isolated outbreaks were found to be of the same serological type.

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THE BONE LESIONS OF YAWS.

OUR knowledge of the manner in which the osseous system is affected in yaws is somewhat scanty and may be summed up as follows: Bone and joint lesions have been found to occur in about 20 per cent. of the cases of yaws inflammation of the periosteum of various bones being comparatively common. The multiple dactylitis so frequently observed in framboesial patients is due to a form of multiple periostitis of the digital phalanges, whilst other lesions of the bones may simulate tuberculosis, central septic abscesses, gummata, hydatid cysts, osteitis fibrosa, enchondromata, endotheliomata, sarcomata, myelomata and secondary carcinomata. X-ray examination reveals these bone lesions as irregularly oval rarefied areas usually in the long axis, parallel with that of the bone. They vary in size, ranging from a few millimetres to two or three centimetres in length. The great majority of the lesions appear to originate in the interior of the bone, although a few of them seem to produce small excavations in its outer surface.

These conditions have been carefully described and reviewed by Mr. Lawford Knaggs[1] who includes a chapter on the affections of the bones in yaws in his recently published studies of the inflammatory and toxic diseases of bone, in which he points out that yaws presents such a great resemblance to syphilis that the late Sir Jonathan Hutchinson suggested the name "framboesial syphilis" for it, a controversy having raged for many years whether yaws is merely a modified form of syphilis or a distinct and separate disease. The latter view now prevails, the causal organism, *Treponema pertenue* of Castellani, having definite characters of its own, although it closely resembles *Treponema pallidum* of Schaudinn in appearance.

Yaws, too, presents primary, secondary and tertiary stages, the manifestations of which closely correspond in point of time, and somewhat in character, with the lesions of similar stages in syphilis.

It will thus be readily appreciated that this controversy as to the true nature of yaws introduces difficulties into any attempt to describe the features of its osseous lesions—a difficulty which is increased by the absence or rarity of well authenticated specimens in the museums of this country.

It is in the tertiary stages of both diseases that the bones are apt to be affected and Knaggs considers that many of the accepted descriptions of the lesions in osteitis and in acute and chronic periostitis ascribed to yaws would apply equally to similar conditions occurring in syphilis. It is otherwise, however, with the epiphysitis in which the epiphyses of the phalanges and metacarpal bones are attacked, the resultant deformities of the hands and shortening of the digits being extraordinarily common.

The investigations of Maul in Manila have thrown a clearer light upon the subject. In 100 cases of yaws accurately diagnosed, bone and joint lesions

[1] "The Inflammatory and Toxic Diseases of Bone: A Textbook for Senior Students." By R. Lawford Knaggs, M.C. Cantab., F.R.C.S., Consulting Surgeon to the Leeds General Infirmary. With numerous photomicrographs by G. H. Rodman, M.D., Hon. F.R.C.S. Bristol: John Wright and Sons, Ltd. London: Simpkin, Marshall, Hamilton, Ke[illegible] and Co., Ltd. 1926.

were found in 20 of them, and in all of these X-ray photographs were taken.

In the majority numerous lesions were present, many being often met with in a single bone. These showed the rarefied areas and superficial excavations described above.

On the articular surfaces excavations appeared on those parts most exposed to injury, and Maul attributes the joint pains in yaws to them, and they possibly provide the explanation of the inflammatory joint conditions and subsequent ankylosis described by others.

A small proportion of the cases showed nodular lesions with swelling over the surface of the bone and localized thickening of the cortex, which sooner or later showed rarefaction of its centre.

In chronic conditions the picture presented by the earlier lesions of the bones disappears. There is marked irregularity of the bony outline, and growth may be interfered with when the epiphyses are affected, which occurs less frequently than involvement of the shafts of the bones.

After treatment with salvarsan the rarefied areas described by Maul rapidly disappeared and regeneration of the bone at the site of the lesions appeared to be complete. They probably constitute some of the earliest manifestations of bone implication, and it may fairly be assumed that they represent small granulomatous masses of similar nature to those which constitute the cutaneous eruption.

Knaggs considers that the multiplicity of the lesions, their widespread distribution, and the more frequent implication of the interior of the bone, present a striking picture and he confesses that he knows of nothing like this in syphilis.

A re-examination has been made by Knaggs of several bones—tibiæ and fibulæ—from New Guinea, now in the museum of the Royal College of Surgeons. They were obtained by S. C. G. Seligman from a collection of native bones from Murua and Kivaiawata, two islands near the eastern end of Papua.

He found that all these bones showed periostitic nodules, some being quite indistinguishable from syphilis. Others, however, present a curious pitted appearance of the surface of the nodes, as if associated with ulceration of the overlying soft parts. In some the upper articular surface presents the condition described by Maul, the pitting being quite different from that of syphilitic affections of the long bones. There is little evidence of syphilis among the native population of these islands, and Seligman considers that if the lesions of these bones are not due to syphilis they can only be ascribed to a disease hitherto not met with which produces similar osseous changes. He states that yaws is commonly but unevenly distributed throughout the Possession, but makes no reference to conditions constituting the tertiary manifestations of that disease. He describes, however, an *obscure* ulcerative condition ("granulomata"), and the accompanying photographs are suggestive of tertiary syphilitic ulceration, though, as Knaggs remarks, it may be that they are really examples of one of the later manifestations of yaws.

Further specimens of the bone lesions of undoubted cases of yaws are badly needed in the museums in this country and if any tropical practitioner who could do so would supply this need he would certainly assist in the advancement of knowledge in an obscure branch of tropical medicine.

F. E. T.

Annotations.

On an interesting Case of Brazilian Bubo (G. Franchini, *Il Policlinico*, January 1, 1926).—This condition was described for the first time in Italy by Breda, of Padua, it is also known as Breda's disease. It is very rare in Italy and the cases are nearly always imported by woodcutters from Brazil where many Italians are employed. Although resembling oriental sore and American leishmaniasis it is a distinctly different affection. Two cases are described: (*a*) an Italian peasant contracted the disease at St. Paulo, Brazil, where he was employed as woodcutter. It started as small nodules, the size of a pin's head, which became ulcerated, exuding small drops of a white-yellowish liquid; the ulcerations became larger and spread over large areas of the foot and legs, arms, hands, nose and mouth. There was a feeling of burning locally, but no fever or other symptoms. He was treated in the hospital of San Paulo by intravenous injections of antimony tartrate, which were well tolerated. After six or seven months' treatment the ulcers began to cicatrize. (*b*) Another case had returned to the province of Potenza, his native place, in good health. After six months he noticed severe irritation in the nasal mucosa with continuous running from the nose as if he had a cold. At the same time the uvula began to be inflamed and sore; the condition quickly got worse and the palate appeared to be covered with many white-yellowish granules. Mastication was not much hindered, but swallowing was difficult. In a nursing home in Naples he had received intramuscular injections of a thick, blackish liquid of which he did not know the name. He was partially cured. About three years later his condition became much worse and he entered the Dermo-Syphilopathic Clinic, Naples, where he was treated with intravenous injections of antimony tartrate. After fifteen days he returned home owing to the closing of the clinic, and after getting worse and with a cough he was admitted to the Colonial School of Pathology, Bologna. Besides the lesions already described, others were found on the elbows, hands, legs and feet. He was completely cured by injections of large doses of antimony tartrate and Roentgen-rays. The microscopical examination showed Leishman-Donovan parasites. The radiographic examination, in spite of the alteration in the mucous membrane of the palate, showed the bone intact, which proves that the case was one of bubo, as this disease never attacks the bones.

Reviews.

A Synopsis of the Families and Genera of Nematoda. By H. A. Baylis, M.A., D.Sc., and R. Daubney, M.Sc., M.R.C.V.S. London: Printed by order of the Trustees of the British Museum, March 27, 1926. Pp. xxxvi + 277.

The process of reorganization, which has been such a characteristic and necessary economic feature of the past eight years, has shown fruitful results in many varied directions. The medical and biological sciences have not escaped this reconstructive process and it has been very evident that a great deal of clearing up and reorientation had become necessary. In no branch, perhaps, was this more evident than in parasitology. Everyone is, of course, to some extent, conscious of much recent activity in this science, but few, probably, realize the enormous amount of progress or, at least, alteration which the past twenty years have witnessed. The result has been the accumulation of a vast amount of new knowledge and the consequent urgent need for its systematization. This need has been met to quite a satisfactory extent by the appearance of several important monographic publications, not the least valuable of which is *A Synopsis of the Families and Genera of Nematoda*, by H. A. Baylis and R. Daubney.

The authors have tackled the matter as pure systematists and, though obviously cognizant of them, have not allowed themselves to be unduly swayed by the many medical and economic aspects of the problem. Students of the medical, veterinary and agricultural sciences are thus provided with a dispassionate catalogue and an unbiased guide.

It is with a certain feeling of thankfulness that we find there is nothing very iconoclastic or irritatingly controversial in the volume. The recent mood of experimental and medical biology has been, we believe, one of conservatism, the tendency being more to preserve and improve what we already possess rather than to speculate unduly on what is to come. It has been, in fact, a period of definite stock-taking and, in accord with this, Baylis and Daubney's *Synopsis* is practically an accurate emended inventory of our stock-in-trade in this particular line.

It is a curious circumstance that, apart from its purely medical aspects, the economic and practical importance of helminthology is only just beginning to be realized in this country. Throughout the whole of last century, while helminthology, like many other branches of applied science, was struggling for recognition, the number of Englishmen who made substantial contributions to the subject was relatively remarkably small, but the past ten or twenty years have demonstrated that this country can produce first-class work on the subject which, if not so ponderous as that published on the continent in earlier years, is possibly of more immediately practical import. Baylis and Daubney's *Synopsis* will undoubtedly afford satisfaction to the academic helminthologist and be, at the same time, of real value to those who have to deal with more practical problems.

W. N.

A Manual of the Parasitology of Man. By Charles F. Craig, M.D., M.A. (Hon.), Lieut.-Colonel Medical Corps, United States Army. Illustrated. Philadelphia and London: J. B. Lippincott and Co. 1926.

This is a very fine book, being, the author states, the fruit of thirty years' experience and ten years' teaching. The important part played by protozoan parasites in human pathology is steadily becoming more widely known, and this book will play a worthy part in encouraging its still wider prevalence.

As parasites protozoa produce some of the most important and serious of human diseases, such as the malarial fevers, amœbic dysentery, sleeping sickness, kala-azar, tropical ulcer and Chagas' disease, and the present volume is heartily welcomed, seeing that it contains all the important facts that have been learned regarding the morphology, life-history, relation to disease, prophylaxis and diagnosis of these parasites, and in it is collected and included much of this information which has hitherto only been available in monographs devoted to special genera or species of protozoa.

Although containing a wealth of zoological information it is expressly denied that this manual is a zoological treatise, but is intended for the use of health officers, medical practitioners, teachers, laboratory and research workers and medical students, and each and every one of these classes of worker are warmly recommended to avail themselves of it.

One looks in these pages in vain for a description of the various pathogenic spirochætes—in fact, the words spirochæte, spironema and treponema do not appear in the index, and the same remark applies to the Rickettsia and to the organisms usually classed as Chlamydozoa. This omission is, however, intentional, for the author considers that there is at present no evidence that any of these organisms are protozoan in nature beyond the personal opinions of those who desire them to be so classed, while there is much evidence available indicating that all these organisms are more closely allied to the bacteria than the protozoa, hence the author's view that they should not be included in a work devoted entirely to protozoan organisms.

There can be very little of real importance that is known regarding the various parasites described that can have escaped discussion, whilst to prevent confusion in diagnosis descriptions of numerous freely-living non-parasitic protozoa have also been included.

The volume, which runs to 569 pages, has been well produced—well printed, well bound, well illustrated, and last, but not least, well indexed.

F. E. T.

Original Communication.

A BRIEF NOTE ON THE MORPHOLOGY, CULTURAL CHARACTERS AND BIO-CHEMICAL REACTIONS OF *VIBRIO-THRIX ZEYLANICA* CASTELLANI.

By N. Bhattacharyya, M.B.Cal.

From the Ross Institute for Tropical Diseases, Putney, London.

History.

Vibriothrix zeylanica was discovered by Castellani in Ceylon in 1904 in the stools of dysentery cases, It was fully described by Castellani in 1910 under the term of *Spirillum* (*Vibrio, Vibriothrix, Spirobacillus*) *zeylanicum* in the *Philippine Journal of Science*, vol. v, No. 2, Section B; *Medical Sciences*, July, 1910. Some years later Castellani created a new genus for the organism: *Vibriothrix*. Since then this organism has been isolated in different countries. In 1917 it was found in Taranto by Castellani, Spagnuolo and Russo. In 1919, Taylor found it in London from a patient from Ceylon, who was suffering from chronic dysentery. In 1922 Delamare and Alalon found it in Constantinople. In 1923 Professor Peruzzi found it in cases of dysentery at Pola, and carried out a very complete investigation on the morphology of the organism.

Pathogenicity.

Though it has been isolated from the stools of dysentery patients, it is believed by Castellani that it does not play any part in the rôle of the disease. The organisms have been inoculated subcutaneously, intramuscularly and intraperitoneally into guinea-pigs and rabbits without any pathogenic effect unless given in massive doses. Castellani considers it to be a noso-parasite.

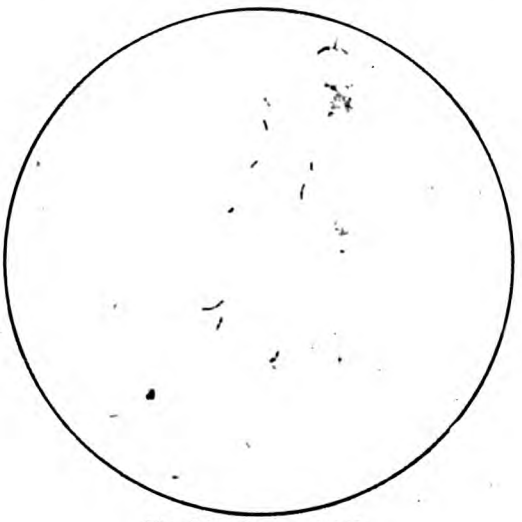
Examination of Fresh Preparation.

Highly motile, always polymorphic in character. The following forms may be seen in preparations from the same medium—coccus-like, bacillus-like. vibrio-like, spirillum-like, spirochætal and vibro-spirillar forms and filamentous forms. All these forms are often found in the condensation water of glucose-agar media, in the pellicle of broth and blood-broth cultures, and in the small amount of broth added to glucose-agar media.

The smaller forms are more motile than the well-formed long filamentous forms. Some of these latter are branching. The organisms which are found in the pellicle itself are less motile than those found in the liquid part of the media. Peculiar globular and club-like formations of various sizes may also be seen.

Stained Preparations.

The organism is easily stained by the ordinary aniline dyes; it is Gram-negative and not acid-fast. In preparations stained with Romanowski, the filamentous forms appear to contain deeply-stained



Blood broth. × 1,000.

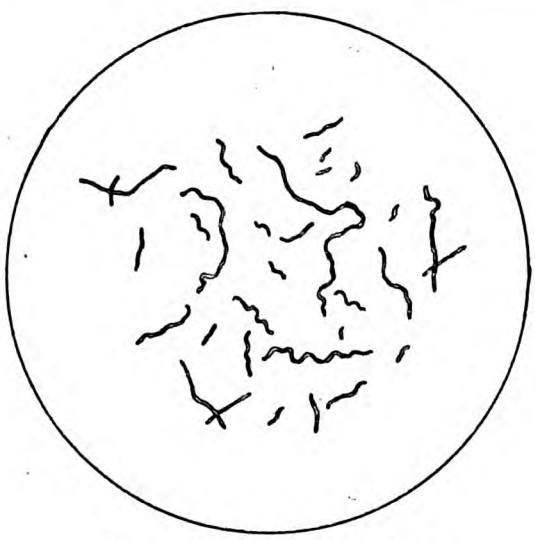


Glucose agar (water of condensation). × 1,000.



Glucose agar (water of condensation). × 1,000.

Pleomorphism of Vibriothrix zeylainca.



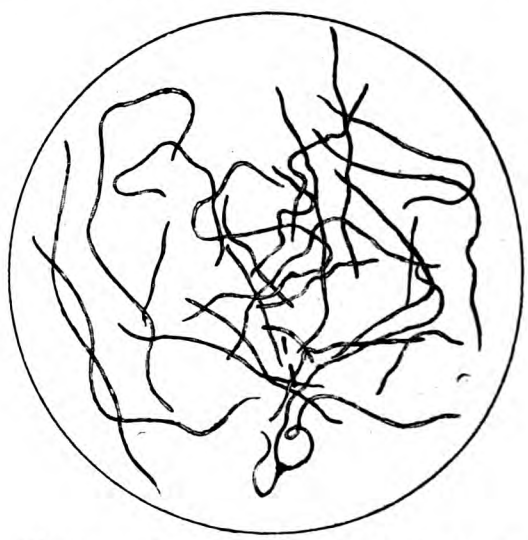
Glucose agar (water of condensation).



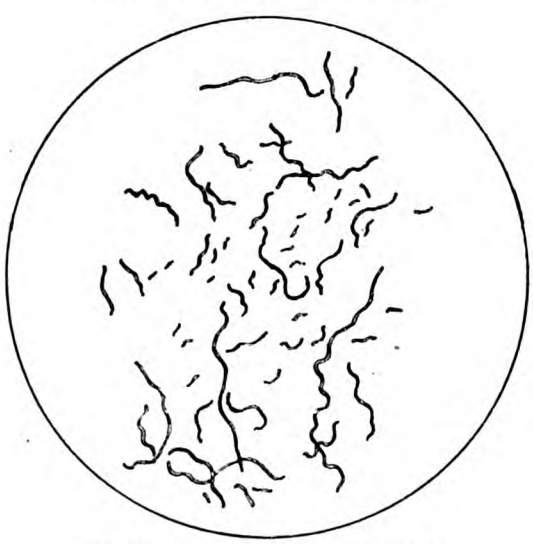
Glucose agar (from pellicle in water of condensation).



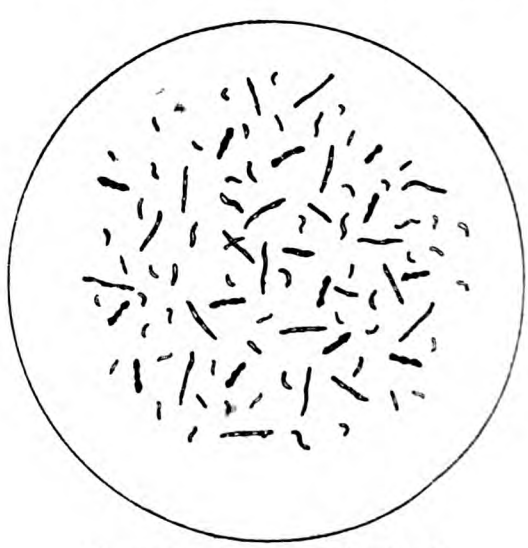
Glucose agar (water of condensation).



Glucose agar (from pellicle, water of condensation).



Glucose agar (water of condensation).



Glucose agar (water of condensation).

PLEOMORPHISM OF VIBRIOTHRIX ZEYLANICA.

VIBRIOTHRIX ZEYLANICA CASTELLANI, 1910

	Incubation period	Motility	Gram	Gelatine	Serum	Litmus milk	Lactose	Glucose	Levulose	Maltose	Galactose	Mannitol	Dulcitol	Saccharose	Inulin	Isodulcitol	Inositol	Adonitol	Arabinose	Amygdaline	Salicin	Sorbitol	Raffinose	Dextrin	Erythrite	Glycerine	Starch	Broth	Indol	Lead agar
Vibriothrix zeylanica Castellani, 1910	May 1	+	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G.T.	+	O
	7	+	O	O	O	Alk.	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G.T.	+	O
	14	+	O	O	O	Alk.	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G.T.	+	O
	21	+	O	O	O	Alk.	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	G.T.	+	O

nuclear bodies. These have been thoroughly studied by Peruzzi.

CULTURAL CHARACTERS.

Grows in almost all the laboratory culture media at 22° C. to 37° C. It grows on potato, producing a peculiar reddish or reddish-brown pigmentation. The pellicles on the liquid media and on the condensation water of glucose-agar media are of a whitish colour. The viability of the germ remains unaffected for a considerable time at room temperature. Growth has been observed in gelatine at 22° C. and 37° C., and in blood-agar gelatine and milk and blood and gelatine at 37° C.

FILTERABILITY.

It is interesting to note that the organism, as first noted by Peruzzi, is a filter-passer using both broth and peptone water cultures. A series of experiments were made with Berkefeld candles, and *B. coli* was used as control. The results were always positive with the vibriothrix. Hanging-drop preparation of the filtrate was examined immediately after filtration under the microscope. On close observation a very few minute coccoid organisms could be seen, though with difficulty, but after half an hour the number of these organisms was found to be increased. Two or three hours after filtration, the globular forms and the bacillary forms were developed in the filtrate. Subcultures in different media showed all varieties of the organism. From this we can draw the inference that very minute coccoid bodies or spores of the organism pass through the filter; and these exceedingly minute coccoid bodies apparently give rise to the various types of organisms.

BIOCHEMICAL REACTIONS.

All the strains have been passed through almost all the important sugars. They do not split any sugar and so do not form acid; the organism produces alkalinity with some of them. It makes litmus milk distinctly alkaline, and does not liquefy gelatine or serum. It does not produce any pigmentation in lead agar.

The morphological characters and biochemical reactions of four different strains isolated in different parts of the world were studied separately. They are identical and give exactly the same reactions. The strains which have been examined by me were an Italian, an American, a Lister Institute and Castellani's original Ceylon strain.

The vibrio form is apt to be mistaken for cholera and the spirochætal form with the spirochæta.

REMARKS.

V. zeylanica, though a non-pathogenic organism, is of interest from a morphological point of view, the organism being very polymorphic, bacillus-like, spirillum-like and spirochæte-like. It also has a certain importance from the point of view of the practical bacteriologist, as the colonies of the organism on MacConkey and other selective media may easily be mistaken for dysentery bacilli colonies, and

the undulating forms observed in the fæces may be confused with spirochætes.

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TROPICAL TYPHUS AND BRILL'S DISEASE.

By William Fletcher, M.D., M.R.C.P.,

AND

J. E. Lesslar, Dipl., Madras.

From the Institute for Medical Research, Kuala Lumpur, Federated Malay States.

Many a virulent disease has its milder counterpart. Such, for example, is virulent small-pox, with its milder facsimile, alastrim; the tsutsugamushi of Japan, which has a mortality of over 60 per cent., and the tsutsugamushi[1] of Sumatra which is rarely fatal; the Rocky Mountain spotted-fever of the Bitter Root Valley in Montana, which kills more than 70 per cent. of its victims, and the spotted-fever of Idaho, which is only one-tenth as deadly.

In like fashion, the dreaded epidemic typhus of Eastern Europe has its feebler image in tropical typhus, which is seldom fatal. Epidemic typhus is essentially a disease of cold or temperate climates, and when an epidemic breaks out in a hot country it usually flares up in the winter and dies down again in the spring. Tropical typhus, on the contrary, is a disease of warm climates and when it occurs in a cool country it appears in the spring and dies down in the autumn.

The symptoms of tropical typhus and of epidemic typhus are the same, both diseases run the same course and, in both, the Weil-Felix reaction is positive. Why, then, should they be looked upon as separate diseases? The reply to this question is that however closely they may be related from an academic point of view, they are totally distinct when looked at from the practical standpoint of the sanitarian and the public. The typhus of Europe is a disease which spreads rapidly and requires energetic measures for its control. Tropical typhus, on the other hand, does not spread directly from man to man; it does not give rise to epidemics: it is not carried by lice, and patients suffering from it can be treated in their houses, or in the general wards of hospitals, without special precautions and without danger to others.

[1] Described by Schüffner, in 1915, under the title of "Pseudotyphoid fever, a variety of Japanese kedani fever."

Tropical Typhus in the Malay States.

Tropical typhus was first recognized, in the Malay States, by the application of the Weil-Felix reaction in two cases of undiagnosed, continued fever where all other agglutination tests had failed. This was in August, 1925, and since that time we have met with more than eighty cases in different parts of the country; in fact, the disease is as common as typhoid fever.

As we have said, the symptoms are the same as those of epidemic typhus. The onset is sudden, usually with chills and sometimes with vomiting or an attack of sneezing. The conjunctivæ are injected and there is nearly always a dry cough. Headache is severe and persistent. The temperature rises rapidly, the severity of the headache prevents the patient from sleeping and, in a case of moderate severity, he passes into a typhoid state towards the end of the first week. He becomes tremulous, is continually muttering to himself and tries to get out of bed in his delirium; yet he can usually give surprisingly intelligent answers to questions. Delirium is present in about 35 per cent.; in mild cases there is none, except perhaps at night, but the patient's mind seems to be clouded, so that he replies to a simple question with effort and delay. The disease develops more rapidly than typhoid fever, and by the seventh or eighth day the patient's condition is more like that of a man in the third week of typhoid than at the end of the first. Sometimes the face has a blue, congested appearance in the second week and the leaden hue of the *facies typhosa* has been noticed in several European patients.

The fever is at its height from the eighth day to the eleventh day; the temperature is about 104° F. and the pulse 120. The lungs are often full of coarse crepitations and the respirations may be increased to 40 or more, even when there is little or no pulmonary involvement. The patient often looks desperately ill, but, suddenly, at the end of the second week there is a great change, the temperature falls and he becomes marvellously better. There is often a little fever for one or two evenings after the crisis, but, thereafter, the temperature remains normal and the patient makes a very rapid recovery. Defervescence usually takes place on about the fourteenth day. The fever terminates by crisis in 40 per cent. of the cases and by quick lysis in the remainder, unless it be prolonged by broncho-pneumonia or septic conditions.

The spleen and the lymphatic glands are frequently enlarged. The knee-jerks may be lost in the second week and occasionally there is slight deafness. A rash which appears on the fifth or sixth day is present in about 40 per cent. of the cases, but it is well marked and conspicuous in very few, and it is difficult to see on the skin of a dark Asiatic. In one of our European patients, a very profuse rash came out on the fifth day and covered the body with slightly raised blotches about 1 cm. in diameter; it was general in its distribution except that there was none on the face. There was not very much on the extensor surface of the arms, but the flexor aspect was thickly covered. The eruption was pro-

fuse over the trunk and thicker on the chest than on the abdomen. When we first saw this patient, on the seventh day of his illness, the rash bore a striking resemblance to the muscular eruption of secondary syphilis. It had become brown and faded by the tenth day, and some of the spots were purpuric, especially on the thighs. As a rule, the eruption is confined to the trunk, uper arms and thighs; sometimes the spots resemble the roseola of typhoid, but, in Asiatics, there is frequently no rash at all, or only a few purpuric macules.

Bronchitis is so common that it may be regarded as a symptom rather than a complication. Occasionally there is severe broncho-pneumonia. The patients are very liable to bed-sores, which are apt to develop rapidly and unexpectedly. Apart from these we have seen no complications or sequelæ and convalescence is extremely rapid.

There have been five deaths among the eighty-six cases which have come to our notice in the Malay States. We were not able to visit these five patients ourselves and no post-mortem examinations were made.

The Weil-Felix Reaction.

The Weil-Felix reaction is always positive in the tropical typhus of the Malay States, but very often it does not become so until the end of the second week . That is to say, it may be negative throughout the course of the fever and become positive only after the temperature has gone down. The titre of agglutination increases up to the end of the third week, or a little later, and then declines; it generally becomes negative in six months or less. Repeated examinations should be made in every case; the evidence of a waxing and waning titre, obtained in this way, is conclusive proof of active disease. As the result of a large number of control tests, we have adopted a serum dilution of 1 in 200 as the limit above which we regard agglutination as positive evidence; in most cases of tropical typhus the maximum titre is well above 1 in 1,000. The tests are made in Wright's pipettes with emulsions of living cultures which are prepared by washing off the twenty-four hour growth from agar slopes with distilled water. The serum dilutions are made with normal saline. The results are read after two hours in the incubator at 37° C.

The Two Groups of Tropical Typhus.

Van Loghem classified *B. proteus* in two groups: the *Indologenes* group, which produces indol in peptone water, and the *An-indologenes* group which does not. We have employed in the Weil-Felix reaction, one an-indologenic strain of *B. proteus* x 19, known as the " Kingsbury " strain, and also a number of indologenic strains. By this means, we have found that there are two groups of tropical typhus, clear cut and distinct from one another, as classified by this reaction. One group, which we will call the K group, agglutinates the an-indologenic strain " Kingsbury," but does not agglutinate the indologenic strains, such as " Warsaw " and No 67 from the National Collection of Type Cultures. The second group, which we call group W, agglutinates the indologenic strains, but does not agglutinate the an-indologenic strain. The two groups appear to be equally common, in the Malay States, and they differ but little in their course and symptoms. In neither group is there any evidence of transmission by lice.

The following tables show the Weil-Felix reaction in a Group K case and a Group W case, respectively, with the an-indologenic strain of *B. proteus* x 19, which is known as " Kingsbury " and the indologenic strains " Warsaw " and No. 67.

Group K Case.

Agglutination of Cultures of X 19 with Blood of Mengah Singh.

Culture	Day of Illness 10	16	20	36	46	62
Kingsbury	500	2,000	4,000	1,000	100	30
No. 67	0	0	0	0	0	0
Warsaw	0	0	10	0	0	0

The figures indicate the highest dilution of the serum a which agglutination took place; e.g., the figure 500 means that agglutination occurred at a dilution of 1 in 500.

Group W Case.

Agglutination of Cultures of X 19 with Blood of Narayanan.

Culture	Day of Illness 10	16	20	36	35
Kingsbury	10	10	10	10	0
No. 67	1,000	4,000	2,000	500	250
Warsaw	1,000	4,000	2,000	1,000	250

Epidemiology and Ætiology.

The tropical typhus of the Malay States has a special tendency to attack cattle-keepers and those whose occupations take them into waste land, covered with grass and undergrowth, where cattle graze. Drivers of bullock-carts, cowherds and agricultural labourers are particulary liable, and we have seen a small outbreak among some European soldiers who were encamped on waste grazing land. The town dwellers, and the Chinese who work in the tin mines of the Malay States, escape infection almost entirely.

No body-lice have been found on any of the patients and there is the strongest evidence that these insects are not the vectors. The patients do not infect the occupants of the houses or tents in which they are taken ill; moreover, though no special precautions have been adopted to free them from lice, when they are admitted to hospital, yet they never infect anyone else in the wards where they are treated. Though the disease is not contagious, in the sense that it spreads directly from man to man, it has a patchy distribution and preponderates in certain districts. In this particular it resembles the tsutsugamushi of Japan and the spotted-fever of the Rocky Mountains, diseases which are akin to typhus in many respects. Small rodents, such as field mice and rabbits, are the natural hosts of the virus of these diseases, man is but rarely infected. The virus of tsutsugamushi is carried by a larval mite and Rocky Mountain fever is carried by a larval tick. None of the patients whom we have seen

... typhus had any recollection ... by ticks or mites, but the larval ... very minute and easily escape notice. ... large numbers of rats in some of the ... cases of tropical typhus occurred in ... States and we have already mentioned ... connection of the disease with cattle. Where ... are cattle and cattle food, there are usually ... as well.

In an outbreak of tropical typhus which occurred near Adelaide, in Australia, workmen engaged in handling wheat were particularly liable to attack: in another group of cases, recently reported from Queensland, people who worked on farms, or who were employed in dealing with grain, were singled out by the disease. There was a plague of mice on the farms at the time these cases occurred, and Wheatland, who described the outbreak, considered that the virus was probably conveyed by an ecto-parasite of the mouse.

The first step in elucidating the ætiology of tropical typhus is the conveyance of the disease to animals and this we have not yet succeeded in doing, either because the patient's blood was not obtained at a sufficiently early stage, or because guinea-pigs, the only animals which we have employed so far, are not susceptible to the virus.

Tropical Typhus in Other Countries.

Tropical typhus is by no means confined to the Malay Peninsula. Similar diseases, which we believe to be identical with it, occur not only in other parts of Asia, but also in America, Africa and Australia. The symptoms and course of the typhus-like disease, in New York, which Brill described in 1898, are identical with the symptoms and course of tropical typhus. In recent years there have been many outbreaks of a similar malady, in different parts of the world, and, in nearly all of these, the Weil-Felix reaction has been positive. The following is a summary of the reports, which have come to our notice, of outbreaks of disease which we believe to have been tropical typhus.

Dr. Nathan E. Brill, professor of clinical medicine in Columbia University, was the first to draw attention to a fever of two weeks' duration, which occurred in New York every spring and summer, and which has been diagnosed and treated up to that time as abortive typhoid. In 1897 he made a special study of seventeen of these cases; he found that the blood did not agglutinate typhoid bacilli nor could these organisms be recovered from the blood or excreta. The symptoms and course of the disease, in these cases, were unlike those of typhoid fever, and Dr. Brill concluded that the so-called "abortive-typhoid" was not typhoid at all, but a distinct, acute, infectious disease of unknown origin, which hitherto had passed unrecognized.

In 1910 he published a second report, based upon the observation of 221 cases in New York. Apart from the negative Widal reaction and the absence of typhoid bacilli, the disease differed from typhoid fever in many other respects. This is clearly shown in Brill's account, of which the following is a summary: The disease began rather abruptly, with a chill; the temperature rose far more quickly than in typhoid fever and within a few days it reached its maximum. The conjunctivæ were congested, the face was flushed, and there was intense headache; sometimes there was rigidity of the neck as well, and lumbar puncture was performed in 8 per cent. of Brill's cases. Bronchitis was nearly always present. The spleen was enlarged in 54 per cent. An eruption came out on the sixth day; it appeared first on the back and abdomen and then spread to the arms and thighs. In some cases, the eruption was identical with that of typhoid fever, except that it did not come out in crops; in others, there was a dull red, maculo-papular eruption which did not disappear on pressure. The periphery of the spots was commonly indistinct and frequently several of them coalesced to form patches. In 6 per cent. the eruption was petechial, "suggesting a typhus eruption more than anything," as Brill remarked. Brill described the course of the disease as follows: "The symptoms remain in full development until about the twelfth day, when the fever abruptly disappears, the rash fades, the headache leaves, the apathy and prostration vanish and the patient feels perfectly well. . . . The most remarkable feature of this disease is that, with the fall in the fever, all the signs clear up and the patient, who may have felt and looked very sick, becomes alert, interested in his surroundings, and says he is well; the headache is dispelled as if by magic; the eruption rapidly fades, and convalescence is established." In one-third of the cases the fever terminated by crisis and the temperature became normal in less than twenty-four hours. The disease occurred principally in the summer months. There was no evidence that it was directly communicable. The case mortality was very low, probably not more than 2 per cent. There was no death among the first 220 cases reported by Brill, but shortly after his account of the disease was published there were four fatal cases.

Brill considered that this disease resembled typhus fever more than it resembled any other disease, so much so that in an epidemic he thought that it would be quite impossible to distinguish it from that malady; but, nevertheless, he concluded that it was not typhus, but another disease apart, as distinct from typhus on the one hand as from typhoid on the other. He based his argument on the following facts. It was not communicable, like typhus; it was not a grave and fatal malady; and, moreover, epidemics of it did not arise although it was constantly present in the community.

Brill's investigations drew the attention of observers in other countries to the occurrence of these mild, typhus-like fevers and, in 1910, a similar disease was reported by Smithson as occurring in the Mossman district of tropical Queensland, among labourers who worked in the sugar-cane fields. Those men who were employed in the factories were not attacked, and Smithson suggested that the disease was conveyed by some insect which lived among the sugar-cane.

In the same year, Conor and Bruch saw several

cases of fever in the environs of Tunis which, they thought, resembled Brill's disease. It began abruptly with rigors, severe headache, and a fever which lasted for fourteen days. An eruption of slightly raised macules appeared on the fifth day or earlier, the eyes were injected and the spleen was enlarged. None of the patients died.

In 1911, MacNaught described a fever in South Africa, the prominent features of which were the same as those of Brill's disease, namely, a sudden onset with intense headache, suffused eyes and a dark-red, maculo-papular eruption which came out on the fifth day and left brown stains when it faded. The fever terminated at the end of fourteen days by rapid lysis or crisis. The patients often appeared extremely ill during the first week, yet none of them died. MacNaught noted the resemblance to typhus fever, but this he excluded on account of the mildness of the disease, and because it was not contagious. He was convinced, however, that the fever which he described was the same as Brill's disease in New York.

The scholarly report which Brill published in 1910 excited considerable interest at the time. All were agreed that the disease was distinct from typhoid; but some considered that it was only a mild form of typhus, and among these was Dr. Friedman, who had considerable experience of epidemic typhus in Russia. The question was investigated by Anderson and Goldberger, in 1912, by means of animal inoculations. They succeeded in infecting monkeys by inoculating the blood of patients who were suffering from Brill's disease. When the monkeys had recovered, they were found to be immune to inoculation of the severe form of Mexican typhus known as tabardillo. Similarly, monkeys which had recovered from infection with the virus of tabardillo were immune to Brill's disease. On these grounds the authors concluded that the fever described by Brill was identical with typhus.

This argument is not very convincing; the viruses of variola and vaccinia are reciprocally protective, but they are not identical. Be this as it may, it appears to have satisfied the medical profession that Brill's disease was nothing, more or less, than a mild form of typhus, and little more was heard of it for nearly a decade.

A paper published by Colonel J. W. D. Megaw, I.M.S., in 1921, aroused fresh interest in the disease. He brought to notice a sporadic and localized form of typhus-like fever in the Kumaon district of the Himalayas which had been investigated by McKechnie some years before The symptoms and course of the Kumaon fever were like those of mild typhus or of Brill's disease. The average duration of the fever was about twelve days. At the end of this period, there was the same sudden and remarkable change for the better, followed by quick convalescence. The congestion of the face and eyes at the beginning of the fever, the extensive rash appearing on the fifth day, the mental condition, the bronchitis and rapid breathing; all these symptoms, which are the common symptoms both of epidemic typhus and of Brill's disease, were observed by McKechnie in the Kumaon fever. Where it differed from epidemic typhus was in its epidemiology; in this respect it resembled Brill's disease, for it was strictly local in its distribution and not liable to occur in widespread epidemics; it was not easily conveyed to others, and there was a pronounced tendency for the disease to attack only a single individual in a household. There was no evidence that the disease was carried by lice and it affected the well-to-do Europeans rather than the poorer natives.

More recently, Megaw, in conjunction with Shettle and Roy, reported a small outbreak at a military camp in Central India. Major Shettle saw fourteen cases in British soldiers and two in Indians. The disease did not spread direct from man to man; no other occupants of any tent in which a case occurred were attacked, and no lice were found on any of the patients.

Since Megaw drew renewed attention to this disease, or group of diseases, its occurrence has been reported in many parts of the world. In 1922, Maxy and Havers saw thirteen cases, in Alabama, of a fever with a macular rash which ran its course in two weeks. The Weil-Felix reaction was positive, and they considered that it was a mild form of typhus. There was no evidence of louse-infestation. The disease showed no tendency to spread and it resembled Megaw's Kumaon fever in its tendency to attack the well-to-do rather than the needy.

In 1923, Hone reported the occurrence of an acute illness closely resembling typhus, which had attacked a number of people who lived in and around Adelaide. The sudden onset, the rash, and the course of the malady were the same as in mild typhus or in Brill's disease, and Hone's description of the defervescence is so characteristic that we give it in his own words: "The delirium becomes marked in the severe cases and the patient looks desperately ill; then, just as one is anxious about the outcome, there is, in the majority of cases, a rapid clearing up of the toxæmia, and defervescence occurs between the twelfth and fourteenth days by crisis or rapid lysis." The Weil-Felix reaction was invariably positive in these cases. Body-lice were found on none of the patients. There was no evidence of direct infection from one person to another. Many of the earlier cases occurred among men who were working on wheat-stacks and the wharf labourers called it "wheat disease."

Typhus in a severe form, known locally as tabardillo, has been endemic in the Mexican plateau, at an elevation of some 2,000 feet, for hundreds of years; but it was not recognized in the lowlands until 1924, when Sinclair and Maxy investigated a small outbreak of mild typhus-like fever in an American cavalry camp on the frontier. Inquiries made among the medical practitioners of the neighbourhood showed that this mild form of typhus had existed for years in the Rio Grande Valley, and some of the doctors had seen hundreds of cases, about 2 per cent. of which were fatal. The fever was characterized by an abrupt onset with headache, rigors and vomiting. The temperature reached its

highest point during the first week, it became remittent in the second week, and it returned to normal about the fourteenth day, usually by lysis, but sometimes by crisis. A typhus-like eruption appeared on about the fifth day. Sinclair and Maxy investigated twenty cases; only three were seriously ill and none died. Three of them were slightly delirious, the majority were dull and apathetic. A slight cough was present in all cases. The Weil-Felix reaction was positive. A few guinea-pigs were inoculated, but they failed to show the characteristic febrile reaction, and they were not immunized against the virus of epidemic typhus. No two cases occurred in any one house; no body-lice were found on the patients, nor was there evidence of direct infection from man to man. Sinclair and Maxy consider that the typhus of the Rio Grande is the same as Brill's disease.

A similar type of fever occurs in East Africa. In 1925 Clearkin drew attention to a typhus-like disease characterized by intense headache, photophobia, prostration, and a rash which appeared on the fifth day. It has been known to practitioners in Nairobi for some years. The Weil-Felix reaction was not positive in these cases; but it was found, subsequently, that the cultures which had been used in the test had become inactive.

In 1926, Wheatland described an outbreak of a non-contagious typhus-like fever among the population of the farms surroundings Toowoomba, in Queensland. This fever resembled Brill's disease very closely; its duration was about twelve to fourteen days; it was characterized by severe headache and a macular rash, like that of typhoid, but more profuse. Defervescence took place by quick lysis or crisis. The mortality was only about 2 per cent. The disease was not carried by lice. The Weil-Felix reaction was invariably positive. There was a plague of mice on the farms in the Toowoomba district, and, in the spring, when the human disease appeared, these rodents were dying in great numbers. The farmers attributed the disease to the presence of the sick mice and they called it "mouse disease." This typhus-like fever was confined almost entirely to those who lived on mouse-ridden farms or who dealt with mouse-infested grain. Wheatland concluded that it was probably transmitted by some ectoparasite of the mouse.

In conclusion, we wish to emphasize the importance of employing for the Weil-Felix reaction not only one but, at least, two cultures of *B. proteus* x 19; both the indologenic and the anindologenic strain should be used in every case; and we take this opportunity to express our readiness to supply cultures to those of our colleagues who are interested in tropical typhus. Emulsions of living cultures should be employed, and repeated tests should be made during the third and fourth weeks, that is to say, after the patient's temperature has come down.

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Comparison of Stoll and Lane Egg-Count Methods for the Estimation of Hookworm Infestation (F. L. Soper, *American Journal of Hygiene*, July Supplement, 1926).—To secure complete egg-counts between-spin stirring of the contents of the Lane tube is necessary, and the Lane count must be "pushed to finality" to be of value as a measure of the number of eggs present; this requires so much time that the method is not practical for field surveys. The Lane "pour-off" removes objectionable *substances from certain stools*, thus increasing the visibility of the eggs; there is, however, a limit to the effective concentration of hookworm eggs by the Lane method. The Stoll suspension does not secure an even distribution of eggs; the frequency distribution of repeated counts on two tubes indicates that variations in count follow the normal curve of random sampling and tend to be compensatory. In lightly infested cases the *actual error in the estimated number* of female worms present should be small, whereas, in heavily infested cases, *the percentage error in the estimated number* of female worms should be small. The Stoll method is greatly inferior to the Lane method as a measure of the rate of infestation in groups containing lightly infested individuals, but it is believed that average Stoll counts are as reliable as average Lane counts for estimating the average degree of infestation of groups containing lightly infested individuals, and are probably superior for the same purpose in groups containing heavily infested individuals. The comparative value of the two methods will depend to a certain extent on the percentage of stools of the type mentioned and the degree of infestation. Egg-per-grm. values are less variable than daily stool weights; but egg-per-grm. counts cannot be blindly accepted as measures of hookworm infestation in individual cases.

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MALARIA IN WOMEN.

ALTHOUGH there would appear to be no sex incidence in malaria, the sexes suffering equally when equally exposed to infection, yet there cannot be the slightest doubt that malaria affects the normal functions of the sex-organs of women in ways that are varied and far-reaching and also exerts marked modifying influences on the course of pregnancy and the puerperium as well as on the diseases peculiar to women.

In considering the effect of malaria on the normal functions of the female generative organs, we cannot ignore the influence of climate on menstruation in the tropical countries in which malaria is most abundantly encountered.

Again, the direct effect of malaria on the female generative organs needs much investigation for its further elucidation. Severe malarial infections in young girls undoubtedly delay both general and sexual development. A condition of infantilism and retardation of puberty may result so that the onset of menstruation is delayed. A small, underdeveloped uterus has been found in some of these cases.

Montèl and Dan Van Cuong have recorded two cases in Annamese girls of eighteen years of age whose development was so retarded by malarial cachexia that they resembled children aged ten years. After the administration of quinine not only did the malaria symptoms clear up, but development commenced to proceed normally and menstruation appeared in due course.

When the malarial infection is contracted after puberty has been established menstruation tends to become scanty and irregular, and complete amenorrhœa is usually present in malarial cachexia. Whether the amenorrhœa in malaria is due to the direct action of toxins on the genital organs or to their indirect action on the endocrine glands cannot be stated, though it would appear that both these conditions may contribute to the result.

It may be said, in general, that as a consequence of any acute general infection there may ensue a period of amenorrhœa, with atrophy of the ovaries, uterus, external genitals and breasts. This, however, is usually a temporary manifestation unless there has been some specific destruction of the ovarian follicles, and it generally disappears when the patient has regained her normal health and strength.

Malaria may also be the cause of metrorrhagia, and it has been observed that the metrorrhagia may share in the periodicity of the disease appearing at a certain time each day.

In the treatment of malarial amenorrhœa the malaria should be energetically treated by the regular systematic administration of quinine followed by the use of iron and arsenic in some easily assimilable form as soon as the malarial symptoms have disappeared.

In considering the effect of malaria on pregnancy and of pregnancy on malaria it may first be noted that sterility is frequently encountered in malaria, which is said to lessen sexual power.

Pregnancy was formerly considered to confer some degree of immunity against malaria, but it is now more generally held that pregnancy *per se* has little or no influence on malarial infection, but that pregnant women are, as a rule, less exposed to

infection. Again, latent malaria is prone to make itself manifest towards the close of pregnancy and in the puerperium

Abortion or premature labour is very apt to occur and the position was summed up by Manson in these words: "Malarial fever is likely to end in abortion unless treated by quinine; if treated by quinine pregnancy culminates in a successful issue, *ergo*, quinine should always be given in malaria in pregnant women." In this opinion he is supported by Goth, who has reported that nineteen out of forty-six cases ended in premature labour, and by Edmonds, who states that this accident is very common in Africa.

On the other hand, Whitridge Williams says that despite the somewhat widespread opinion to the contrary it would appear that the ordinary forms of malaria have but little influence on the course of pregnancy. None of his fifteen cases aborted, and in but two did pregnancy end prematurely and then only a week or so before term. He admits, however, that it is possible that the pernicious forms of malaria may have a much more deleterious effect. There is also, he states, a marked tendency toward recrudescence of the disease during pregnancy and the puerperium just as is frequently observed after surgical operations. As regards the use of quinine Williams believes that it should be administered unhesitatingly to women suffering from malaria during pregnancy, as its oxytoccic powers are apparently in abeyance under such conditions, so that it can be used with impunity without fear of setting up uterine contractions. During the puerperium malaria usually presents atypical symptoms often resembling those of sepsis, so as to simulate puerperal fever, though it should not be very difficult to differentiate the two. They may, of course, co-exist in the same patient, when the diagnosis is by no means simple.

Puerperal eclampsia is said to be more common in malarial districts than elsewhere. Subinvolution of the uterus and post-partum hæmorrhage are also common accompaniments of puerperal malaria.

Malarial mastitis, too, is sometimes encountered and generally ends in resolution. Lactation is apt to be difficult and there may be actual suppression of the milk secretion.

As to the fœtus itself, it may also suffer from malaria, but there still seems to be no consensus of opinion as to the possibility of placental transmission of the plasmodium from the mother to the child with the production of true congenital malaria. F. E. T.

Annotations.

A Case of Infection with Lagocheilascaris minor (Leiper) (J. L. Pawan, *Annals of Tropical Medicine and Parasitology*, June 24, 1926).—Specimens of the worms obtained from the tumour mass and the tonsil, transmitted to Professor Leiper were identified as *Lagocheilascaris minor*, and were first described by him in 1909 in cutaneous abscesses in Trinidad, and have since been found by him among specimens received from Dutch Guiana.

Modifying the Course of Infections with Bird Malaria by Changing the Sugar Content of the Blood (R. W. Hegner and M. S. MacDougall, *The American Journal of Hygiene*, July, 1926).—There seems to be no doubt from the data obtained that an increase in the sugar content of the blood modifies the course of the infection, bringing about conditions favourable for the parasite, and hence prolonging the infection until death results. According to certain hypotheses, decreasing the sugar content of the blood should bring about unfavourable conditions for the parasite. Attempts to do this with insulin have been made with suggestive, but not conclusive, results.

Is the Formation of Guarnieri Bodies an Exclusively Mammalian Response to Infection with the Vaccine Virus? (H. B. Andervont, *American Journal of Hygiene*, July, 1926).—So far as the formation of cell inclusions in the rabbit is concerned, these conclusions bear out those of Kadowaki. Neither in the cornea nor in the skin were any structures found following the inoculation of the epithelioma contagiosum virus (poultry pox virus) which even remotely bore any resemblance to either the Bollinger bodies or the Guarnieri bodies, while the latter appear uniformly and typically following inoculation of the vaccine virus.

Animal Infections with the Trophozoites of Intestinal Protozoa and their Bearing on the Function of Cysts (R. W. Hegner, *American Journal of Hygiene*, July, 1926).—Trophozoites of certain intestinal protozoa may pass unharmed through the anterior portion of the alimentary canal and apparently may set up infections in the regions where they are normally localized, but that this probably is not the usual method of infection in nature. The cyst stage is, therefore, the dangerous stage so far as the transmission of these protozoa to new hosts is concerned, and efforts for prevention and control should be directed as heretofore toward this stage in the life history of the organisms.

New Data on Differential Fertility in the United States (Raymond Pearl, *American Journal of Hygiene*, July, 1926).—In the American population it appears that the professional, clerical, trade, domestic and personal service, public service and transportation occupational classes are reproducing themselves in such manner as to maintain about in its present status their relative representation in the population. The heavy labouring classes—manufacturing, agriculture and mining—are reproducing themselves greatly in excess of their representation in the population; they not only have a higher proportion of more fertile families per unit of population so occupied than do the other occu-

pational groups, but also they have a larger average number of children per family. The racial, social and economic significance of these results will be discussed in a further paper.

Relationship of Plankton to Anopheline Larvæ (L. T. Coggeshall, *American Journal of Hygiene*, July, 1926).—Larvæ dissections were carried out to determine whether the anopheline species exhibit preference for certain types of food. The three species examined showed no discrimination in their selection of food. Repeated observations on the food materials available in the various breeding places indicated that the larvæ adapt themselves to the food supply of the water in which they find themselves. The adult female may show some discrimination in selecting a place in which to lay her eggs, having been attracted to it by the plant odour emanating from it. It is impossible to say whether or not the eggs of some species are laid in unaccustomed places where larvæ perish before reaching maturity. It would seem that the latter is not the case.

Studies on the Ætiology of Epidemic Encephalitis. I. The Streptococcus (A. C. Evans and W. Freeman, *Public Health Reports*, June 4, 1926).—A pleomorphic streptococcus highly virulent for rabbits when inoculated intracerebally was obtained from the nasal washings, heart blood and mesencephalon of a case of epidemic encephalitis. In so far as the comparative tests have been made, this streptococcus agreed with the streptococci obtained from cases of epidemic encephalitis by Von Wiesner and by Rosenow. Apparently several other investigators have cultivated the same organism in their studies of the disease. When inoculated intravenously into rabbits the streptococcus shows a tendency to elective localization in the brain. In rabbits and in monkeys it produces nervous symptoms which in some cases simulate the disease in man. Rabbits inoculated with this streptococcus show no inflammatory lesions outside the central nervous system. The meninges are heavily infiltrated with lymphocytes and leucocytes, the inflammation spreads to the cerebral substance by direct extension and along the small vessels penetrating into the brain. There are severe parenchymatous degenerative changes in the nervous tissue and reaction of the neuroglia. The sheaths of the blood-vessels are infiltrated by lymphocytes. The reaction is sometimes most marked in this mesencephalon. In monkeys there is a greater tendency towards leucocytic reaction, and in two instances large areas of hæmorrhagic inflammation in the basal ganglia were noted.

Comparison of the Potency, Polyvalency and Therapeutic Action of Antimeningococcus Serums (A. Wadsworth, M.D., and M. B. Kirkbride, *The American Journal of Hygiene*, July, 1926).—Further experience confirms the conclusions of previous papers that in the absence of any method of titrating toxin-antitoxin neutralization in antimeningococcus serum, the agglutination test is the simplest, most satisfactory and practical method of standardizing these serums when standard cultures, representative of the recognized groups of meningococci are used with a standard serum for purposes of comparison. There is no evidence of lack of therapeutic potency or polyvalency in serums possessing the high agglutinative activity with these cultures. Failure of a recently isolated meningococcus culture to agglutinate in a serum is not necessarily indicative of lack of therapeutic potency. The immunization of horses with six selected representative strains apparently produces serums of higher titre and polyvalency than with a larger or smaller number of strains. Both the titre and the polyvalency may be sacrificed by the addition of too large a number of strains. On the whole, the results of serum therapy in the series of cases reported in this paper show an unusually low mortality, despite the unfavourable conditions under which many of the cases were treated. A few cases did not respond to treatment; a few reacted favourably and then, suddenly, fatal conditions developed in the meningeal processes of the central nervous system or in the course of some complicating secondary infection. The importance of early diagnosis and prompt serum treatment is confirmed, but striking results were recorded in some of the cases treated late in the course of the disease.

The Neoplastic Nature of Lymphatic Leucæmia and its Relation to Lymphosarcoma (W. A. Evans and T. Leucutia, *The American Journal of Roentgenology and Radium Therapy*, June, 1926).—Three cases of lymphosarcoma are described which in their terminal stages changed into lymphatic leucæmia. These three cases are the only lymphosarcomata in a group of sixteen patients treated by deep Roentgen-ray therapy during the last four years, which had a fatal termination. In all three cases radiation therapy produced prolongation of life with entire disappearance of the manifest lesions treated, but later extension of the bone-marrow occurred. At the time of the bone-marrow involvement, all three patients had developed the picture of lymphatic leucæmia. Evidence is thus brought that lymphosarcoma, if life is sufficiently prolonged, may change into lymphatic leucæmia. This happens as soon as the bone-marrow involvement becomes the predominating feature of the disease.

Epidemiological Consideration of the Transmission of Kala-azar (L. E. Napier, *Indian Medical Research*, February, 1926).—There is considerable evidence in favour of the hypothesis that man forms an essential link in the endless chain of kala-azar transmission, but the hypothesis is not proven. There is very strong evidence that the disease can-

not be spread without the aid of an intermediate host. The transmitter is probably a blood-feeding arthropod; on epidemiological grounds only it seems most probable that it is a member of either the genus *Phlebotomus* or the genus *Culicoides*. In the case of most arthropods which have been suggested as possible transmitters of the disease there are numerous epidemiological observations which negative the suggestions, but in the case of *Phlebotomus argentipes* every single epidemiological observation seems to be in keeping with the theory that this insect is the transmitter of the causative organism of kala-azar. Although it is possible that at some future date our knowledge of the geographical distribution and habits of other species of arthropod may point to still other possible hosts, at the present time on epidemiological grounds *Phlebotomus argentipes* can claim the first place in the list of possible transmitters of kala-azar. The obtaining of a more exact knowledge of the distribution of *Phlebotomus argentipes* in the Indian Empire appears to be a most important step towards proving that this insect is the transmitter of kala-azar in India.

Studies on Oral Infection with Ankylostoma (S. Yokogawa and T. Oiso, *American Journal of Hygiene*, May, 1926).—When the mature larvæ of *Ankylostoma caninum* are given to guinea-pigs, rabbits or mice *per os*, most of them penetrate the wall of the alimentary canal and migrate to the lungs through the blood-stream and lymphatics in the same way as following skin infections, and from there go into the alimentary canal via the bronchi, trachea, larynx, pharynx and œsophagus. Some of the larvæ ingested by these animals may first migrate into the abdominal cavity, boring through the wall of the alimentary canal and from there penetrate the liver or into the pleural cavity and the lungs and then take the migratory course, as above, to the alimentary tract. On the other hand, when the mature larvæ of *A. caninum* are given *per os* to the proper host, the dog, they generally do not travel in the body of the host, but grow in the alimentary canal without any such migration. The fact, therefore, that in the case of skin infections the larvæ pass through the lungs has no special connection with the development, nor with the acquisition of resistance against the digestive juices, but is, one might say, a case of *force-majeure*, the larvæ being inevitably carried or guided there by the blood or lymphatic stream.

An Occupational Disease among Zinc Workers (C. P. McCord and A. Friedlander, W. E. Brown and D. K. Minster, *Archives of Internal Medicine*, May 15, 1926).—In a small galvanizing plant, the authors have detected widespread gastro-intestinal conditions, varying from gastro-enteritis, in the younger workers, to well-established gastric and duodenal ulcers among workers employed for a long time. Twelve out of fifteen workers employed seven years or longer have presented severe gastro-intestinal lesions. In a second plant, in which all employees were new at this work (less than six years) and in which the general work conditions are better and exposure to trade process fumes is much less, no cases of this gastro-intestinal disease were found. The authors have shown the accidental formation of zinc sulphate and zinc chloride at levels and under conditions that involve exposure on the part of the workers in the first-mentioned plant. In all workers whose urine has been tested, zinc has been found in quantities in excess of the accidental urine content from food, galvanized iron pipes, &c. These patients have not presented the characteristics of other occupational disease hazards attending galvanizing. The authors have sought to stress the occurrence of multiple hazards in the galvanizing industry. On this account it is felt unwarranted in drawing any precise conclusions as to the ætiologic factor in these cases. Although one attaches significance to zinc as a causative agent various other substances are accepted as possible contributing factors. It is also believed that the unhygienic conditions of the workplace, together with the physical type of worker, favour the occurrence of the conditions described. A close resemblance is seen between the authors' observations of lesions among zinc workers and the findings in the literature referred to by them in which study has followed the administration of single, chemically-pure substances. The concept that zinc is capable of producing chronic systemic poisoning is aided by the work of several authors establishing stored zinc in appreciable quantities in various organs and tissues and in excreta of zinc workers, long after the discontinuance of zinc work; by the creation of alimentary tract lesions by pure zinc salts administered intravenously and by mouth. A long period of time, expressed in years (from five to twenty), appears necessary for the production of the lesions described.

The Morphology and Cultivation of Embadomonas cuniculi (n.sp.) (J. Collier and W. C. Boeck, *The Journal of Parasitology*, March, 1926).—*Embadomonas cuniculi* (n.sp.) is an uncommon parasitic flagellate of rabbits; it was found in the cæcum of only two out of more than fifty rabbits examined. It is ovoid in shape, averaging 9·5 by 5·5 microns. It possesses a cytostome with chromophilous, rigid lips; an anteriorly situated nucleus with a central karyosome connected by a rhizoplast with the centrosome on the nuclear membrane; and two flagella, one a long thin anterior flagellum and the other a shorter and thicker cytostomal flagellum, each arise from a separate blepharoplast. The grape-seed shaped cysts measure 5 to 6·5 microns by 3·5 to 4 microns. They contain a central nucleus and the cytostomal fibre and both blepharoplasts of the motile organism. Division occurs by binary fission, with the nucleus passing through the various stages of mitosis. The plane of plasmotomy is morphologic-

ally longitudinal. *E. cuniculi* was cultivated in Locke egg-serum (L.E.S.) medium, both at room temperature and at 37° C. The cultures at room temperature lived longer. Attempts to cultivate *E. cuniculi* in a medium such as is used for the growth of free-living non-parasitic protozoa resulted in failure and demonstrated that this organism is a parasite (commensal). Attempts to infect young chicks with *E. cuniculi* indicated that since the chicks were infected for only a short time they could not serve as proper hosts for this flagellate. This seems probable also in the case of the rat.

Gastric Secretion in Diabetes Mellitus. Report of Ten Diabetic Patients who had Diarrhœa and Achlorhydria (B. D. Bowen and A. H. Aaron, *Archives of Internal Medicine*, May 15, 1926).—Fractional gastric analyses have been made on sixty-nine diabetic patients. On critical analysis this group cannot be considered as strictly representative of diabetes as it would be seen in a large group of cases, because of the inclusion of a number of patients who were studied some time before on account of diarrhœa, and also because the majority were hospital cases, which are possibly more severe than the average. A complete absence of free hydrochloric acid was found in twenty patients, or 29 per cent. Of these, ten had diarrhœa, while no cases of diarrhœa were found in which the patients had free hydrochloric acid. The artificial use of dilute hydrochloric acid did not appear to affect the diarrhœa in four patients, three of whom died, one having marked steatorrhœa. In the other six patients, the diarrhœa stopped coincidenly with the use of the acid, but did not reappear when the acid was withdrawn. The patients, however, in all instances took the acid over a period of several months. There was no reappearance of free hydrochloric acid in one case that was subsequently studied. Of the twenty patients who had achlorhydria, the average duration of the diabetes was 6·5 years and diabetes was severe in every case at the time of observation. The duration in the normal group was 2·8 years, while the gastric subacidity group held the middle position, with an average of 3·6 years. There was no essential difference in the average ages of the patients in the three groups. In an analysis of the complicating factors in each case, it does not appear that the conditions that are known to produce achlorhydria in non-diabetic subjects are more prevalent in the achlorhydria group. From the result of these observations it seems justifiable to presume that achlorhydria may be the result of long standing or severe diabetes.

Cultivation of Trichomonas, Thermal Death-Point Anaerobic Conditions, Attempts at Sterilization (J. M. Andrews, *The Journal of Parasitology*, March, 1926).—The serum-saline-citrate medium has proved to be the most satisfactory medium for the cultivation of certain trichomonas. Saturation of the medium with oxygen or carbon dioxide has no significant effect on the growth of the flagellates. Cultures remain positive twice as long when covered with paraffin oil. *Pentatrichomonas ardin-delteili* grows better in a medium containing 2 per cent. of human blood-serum than in one containing greater amounts. It does not multiply in a medium containing 10 per cent. of human blood-serum. Room and ice-box temperatures are both unfavourable. *Trichomonas muris* gave similar results when inoculated into media containing rat blood-serum. *P. ardin-delteili* grew better in a medium containing rat serum than in media containing sera from man, rat, rabbit, guinea-pig or monkey. *T. muris* grew best in a medium containing monkey serum. The addition of dextrose brought about an increase in the number of *T. muris* in the culture and also a prolongation of the life of the culture. *P. ardin-delteili* did not survive in culture media containing 75 per cent. or more of nutrient broth. Nutrient broth in lower percentages was not favourable for the cultivation of this species. Trichomonas from man, monkey and rat grew as well in media containing sterilized Löffler's inspissated blood-serum as they did when this serum was not sterilized. *Thermal death-point*: Trophozoites of the seven species of trichomonads studied were killed at a temperature of 49° C. *Anaerobiasis*: Trichomonas of the five species studied lived and multiplied under conditions which indicate that they are facultative anaerobes. *Sterilization of cultures*: Attempts were made to free trichomonas cultures from bacteria by the following means: washing, dilution, mechanical obstacles and traps, fresh egg-white mercurochrome, butyl and butylyl resorcinol. Eventual success will probably be obtained by combinations of these methods, especially with the aid of filtration, which gave the best results.

Further Observations on the Transmission of Cutaneous Leishmaniasis to Man from Phlebotomus papatasii (S. Adler and O. Theodor, *Annals of Tropical Medicine and Parasitology*, June 24, 1926).—The infection rate of sandflies with Herpetomonas in Jericho was found to be about one per thousand during 1925. The morphology of naturally occurring Herpetomonas in *Phlebotomus papatasii* is described. Two out of three experiments in transmission of cutaneous lieshmaniasis from sandflies naturally infected with Herpetomonas were successful. Sandflies were artificially infected with *H. tropica* by feeding on oriental sores, 10 per cent. of the sandflies being infected. Attempts to transmit oriental sore to seven volunteers by eleven inoculations with material from sandflies artificially infected with *H. tropica* were all negative within an observation period of three and a half to four months.

Studies on the Epidemiology of Scarlet Fever (A. S. Pope, *American Journal of Hygiene*, May, 1926).—On the basis of attack rates, the age dis-

tribution of scarlet fever cases in Providence corresponds closely to that usually described in American cities. The greatest incidence is at 6 years. Approximately 75 per cent. of all cases occur under 10 and 90 per cent. under 15 years. The highest mortality in scarlet fever precedes the mode of morbidity and occurs in the third year of life. This is explained by the distribution of case fatality, which is highest during the first year and relatively low after the fourth year. In Providence 52 per cent. of all deaths occur under 5 years, and 80 per cent. under the age of 10. In the past forty years there has been a relative shifting of mortality from the lower to the higher age-groups. Attack rates in Providence show a slight excess among males up to the sixth year of life and at all ages above 7 a marked excess among females. This apparent difference in the susceptibility probably depends upon two factors, viz., a physiological difference in susceptibility of the sexes at different periods of life, and increased exposure among females, especially in the higher age-groups. A similar ratio is noted in the mortality rates, but the excess among males under 5 is more noticeable. For all ages the case fatality rates are about 20 per cent. higher among males. Although varying in different years from October to June, the month of greatest incidence for scarlet fever is usually January. In all but three years out of forty the minimum incidence has occurred in July or August. The seasonal distribution of deaths differs but little from that of cases, but is less well determined. Case fatality fluctuates considerably from month to month, but shows no evidence of trend or definite seasonal variations. There has been no appreciable change in the recorded morbidity of scarlet fever in Providence or in American cities as a whole during the past 40 years. In Providence attack rates have remained practically constant in all age-groups except in infants, where a significant downward trend is apparent. No evidence of periodicity in the incidence of scarlet fever can be seen in the Providence figures nor in the morbidity data from some fifty large American cities for the period 1890-1920. While the morbidity of scarlet fever has remained practically constant since 1885, the mortality rates in Providence have fallen from approximately 40 to 2 per 100,000. The decline has been equally remarkable in most American cities. Where scarlet fever in Providence formerly was responsible for 5·3 per cent. of all deaths it is now the recorded cause of only 0·3 per cent. of total deaths. That this fall in mortality is due to decrease in malignancy of the disease seems probable on the evidence available. There is no reason to assume that control measures have been appreciably responsible for this decline in the mortality of scarlet fever. The decline in case fatality has been practically as great as that in mortality. This is especially marked in the age-groups under five. Case fatality may or may not be higher in eipdemic years and there is no evidence of a significant correlation between case fatality and morbidity rates. Among 22,000 cases of scarlet fever, 271 were recorded as second attacks. It seems probable that this is an under estimate of the percentage of recurrence of scarlet fever in the individual. That one attack does confer a relative immunity is indicated by the fact that only 14 per cent. as many cases were recorded among those who previously had the disease, as among the general population. A marked preponderance of females in the higher age-groups among recurrences is further evidence that infection with scarlet fever depends to a great extent upon the intimacy of contact with cases. Although secondary attack rates in the family vary widely from year to year, there is no significant correlation between such rates and the general prevalence of the disease in Providence. That is, there is no evidence that the disease is in itself more infectious in epidemic than in non-epidemic years. The epidemic curve of the scarlet fever, as determined by the outbreak of 1923-24 in Providence, is essentially a normal distribution.

Observations on the Development of Hookworm Larvæ (P. A. Maplestone, *Annals of Tropical Medicine and Parasitology*, June 24, 1926).—This series of experiments shows that urine has definite effect in destroying both hookworm eggs and freshly-hatched larvæ. It has been noted that it is somewhere between nine and fourteen days before all the hookworm eggs in fæces are killed by urine. In one experiment the eggs must have been in a condition to hatch out, so it must be assumed that urine-moistened soil will kill young larvæ. Miniagawa, working with *Ankylostomum caninum*, showed indirectly that urine killed the larvæ of this species, for he failed to infect young dogs that were placed on soil that had been heavily infected with fæces containing eggs of *A. caninum* and which had been moistened with urine previously, whereas in his control experiments the dogs became infected. The inference drawn by Minagawa was that the larvæ of *A. caninum* were killed by contact with human urine, and the writer's experiment shows that the same applies to the larvæ of hookworms infecting human beings. In another experiment it was seen that the packets of fæces were only partly submerged in water, and the result was that after five weeks there was no dearth of hookworm eggs; in another, however, in which the fæces were totally excluded from contact with air, all the eggs failed to hatch after the same period of immersion. Khalil found apparently normal undeveloped hookworm eggs in the effluent septic tanks of British Guiana and he concludes that septic tanks of the type investigated are of no use in preventing the spread of ankylostomiasis except by concentrating the infective material into one channel. As there was apparently no way of knowing how many eggs entered the tanks it is not possible to say if any were killed during their passage through the system The present series shows that after four days' complete immersion in water about 25 per cent. of the eggs were destroyed, and there is a steady diminution in the number of viable eggs recoverable from water as immersion is continued, until after a period

of five weeks all the eggs seem to be dead. From these observations it seems safe to conclude that septic tanks would have some effect in reducing hookworm infection, the actual reduction being directly dependent on the time the fæces remained in the tank.

Meningitis due to Bacillus enteritidis Gaertner (G. Stuart and K. S. Krikorian, *The Journal of Hygiene*, July, 1926).—It would appear that only nine cases of meningitis have been traced to the paratyphoid group of organisms: seven to *B. paratyphosus* B, one to *B. paratyphosus* A and one to a bacillus of undifferentiated type. The case here described is unique in so far as no reference has been found in medical literature to meningitis due to *B. enteritidis* Gaertner. The patient was a boy of eleven years, residing in Jerusalem. He was sent to the hospital as a case of enteric fever, but was found to be suffering from symptoms of meningitis, and later passed into a state of complete coma which lasted until his death fourteen days after entering hospital. Agglutination tests showed the organism to be of the type *B. enteritidis* Gaertner with fully developed labile antigen; it possessed labile and stable receptor apparatus identical with those of typical *B. enteritidis* Gaertner.

A Second Case of Sleeping Sickness in the Sudan caused by Trypanosoma rhodesiense (R. G. Archibald and D. Riding, *Annals of Tropical Medicine and Parasitology*, June 24, 1926).—The clinical history of this case of human trypanosomiasis and the morphological characters of the trypanosome in the blood of rats inoculated with the gland juice of the patient, supports the view that this was a case of human trypanosomiasis caused by *T. rhodesiense*, a hypothesis which received further confirmation by testing the pathogenicity of the trypanosome in the white rat, gerbil, monkey, rabbit and guinea-pig. The posterior nucleated forms were not found in the gland juice of the patient, but appeared in an unusually high percentage in the blood of inoculated rats, constituting nearly 20 per cent. of the short broad forms of the trypanosomes in the first series of inoculated rats. Sub-inoculations carried out in these animals showed that the posterior nucleated forms averaged from 5 per cent. to 13 per cent. of the short broad forms, the percentage varying with the duration of the infection in the inoculated rats. The previous record of *T. rhodesiense* in the Sudan (1922) was a case of human trypanosomiasis in a native of the same district of the Bahr el Ghazal; gerbils inoculated with the gland juice from this case showed the presence of posterior nucleated forms in peripheral blood-films, these forms occurring also in subinoculated white rats and a dog. The measurements of the trypanosomes were very similar to those of the second case, varying from 10 to 30 microns. The pathogenicity of the trypanosome from the two cases resembles that of *T. rhodesiense*. The two cases are of interest inasmuch as they occurred in natives of the Tembura district of the Bahr el Ghazal, a sleeping sickness area in which *T. gambiense* is endemic and in which the tsetse-flies *G. fuscipes* and *G. morsitans* abound. Thanks to the energetic and successful measures for dealing with sleeping sickness, the malady in the Bahr el Ghazal appears to be under control, but the danger of infected cases crossing the western frontier from adjacent territories is a real one, necessitating close co-operative measures with the countries concerned. So far, the common form of human trypanosomiasis has been caused by *T. gambiense*, but the authorities are fully alive to the possibilities of *T. rhodesiense* occurring in man in a country where *G. morsitans* is almost ubiquitous and where game and stock act as reservoirs of *T. pecaudi* vel *brucei*. The two cases reported indicate so far that human trypanosomiasis caused by *T. rhodesiense* exists in the Bahr el Ghazal only in sporadic form.

The Clinical Value of Hay's Sulphur Tests for Detecting Bile Acids in the Urine (W. I. Gerrard, *Journal of the Royal Naval Medical Service*, July, 1926).—Hay's sulphur test is very simple and is of much clinical importance in investigating the relative excretion of bile-salts and bile-pigments. It is of particular interest in the study of salvarsan and dissociated jaundice. The modified technique should be used. The reaction of the urine and its specific gravity do not in any way affect the accuracy of delicacy of the test. Compared with Pettenkofer's test the delicacy of Hay's reaction is marked. The many fallacies in applying Pettenkofer's test render it almost useless; one part of bile-salts in 1,000 gives only a doubtful reaction. The causes of error in interpreting Hay's test are easy to avoid. The test reveals the presence of bile-salts in slight liver lesions hitherto unobserved. A haphazard technique in the use of Hay's sulphur test will lead to entire failure to recognize cases in which bile-salts are present in the urine in small amount.

The Estimation of the Number of Hookworms harboured, by the use of the Dilution Egg-Count Method (R. B. Hill, *The American Journal of Hygiene*, July Supplement, 1926).—In order to check the suggestion of Stoll that the factor 44 represents the average egg output per grm. of fæces per female hookworm, and that such a factor can be used to estimate the number of parasites when only eggs per grm. are known, the total egg output of 96 heavily infested cases was estimated for two or three days and compared with the number of worms recovered after treatment to a cure. A positive correlation was found between each of the items: the total daily egg output, the number of eggs per grm. basis formed, and the number of female hookworms harboured. The calculation resulted in finding that the factor 18·3 represented the number of eggs per grm. per female in this series. This factor, when

applied to the egg-counts in a series gave a close estimate of the number of female hookworms harboured, but when applied to the other groups was usually too low. Stoll's proposed factor of 44 was too high. It was found that fæces recovered could be classified as formed, soft, or mushy, and that the average amounts of these classes, per day, were 147, 226 and 314 grm. respectively, a ratio approximately 1 : 1·5 : 2. It is suggested that for comparison all counts per grm. be reduced to the basis of formed stools by the use of the proper factor. As the number of worms harboured increases, the egg output per worm decreases.

The Proportion of Viable Bacilli in Agar Cultures of Bacillus aertrycke (Mutton) with special reference to the change in size of the organisms during growth, and in the opacity to which they give rise (G. S. Wilson, *Journal of Hygiene*, July, 1926).—Working with agar cultures of a strain of *B. aertrycke* (Mutton) it was found that the number of organisms requisite to cause a given opacity was five times as great in a 26-hour as in a 4-hour culture. This difference is probably explicable by the fact that bacilli from young cultures are larger than those from old ones. Evidence is produced which suggests that the opacity method gives a measure not of the number of organisms but of the total quantity of bacterial protoplasm in the suspension. It should therefore be of special value in the standardization of vaccines. It is pointed out that the opacity method when used for the enumeration of bacteria is subject to a considerable error, and is hence unsuitable for accurate work. A technique is described for the estimation of the proportion of viable to total organisms in an agar culture. The results obtained are closely similar to those already described for broth cultures. The maximum proportion of living bacilli is reached at the end of the logarithmic phase of growth, where about 80 per cent. of the organisms are alive and capable of reproduction. It seems probable that there is a mortality amongst the bacilli that are generated in the early stages of growth, the least resistant organisms failing to divide.

Reviews.

SOME DEVELOPMENTS OF HARVEY'S DOCTRINE "OMNE VIVUM EX OVO": being the Harveian Oration delivered before the Royal College of Physicians of London on October 19, 1925. By Sir Frederick Mott, K.B.E., M.D., LL.D., F.R.C.P., F.R.S. (Consulting Physician, Charing Cross Hospital, London). John Bale, Sons and Danielsson, Ltd. London. 1925.

This learned and eloquent oration by the late Sir Frederick Mott deals chiefly with the evidence of heredity in certain types of mental disease, especially dementia præcox, and with the part played by heredity in the ætiology of mental disease. He discusses also the tendency there is to end or mend a degenerate stock. A select bibliography concludes the brochure.

F. E. T.

THE HEALTH OF THE WORKERS. By Sir Thomas Oliver, M.A., M.D., D.Sc., LL.D., D.C.L., F.R.C.P., Professor of the Principles of Medicine, University of Durham. Faber and Gwyer, Ltd. (The Scientific Press). London. 1925.

This small volume is one of the series of Modern Health Books edited by Professor Fraser Harris, which are designed to bring within the reach of everyone the latest expert opinions on the chief problems of health. Sir Thomas Oliver has written the book to meet the growing interest taken by the public in medical and social problems connected with industrial occupations and has accordingly avoided using too technical language. He has, nevertheless, provided much useful information which cannot fail to interest medical men also, and which bears the personal impress of a great authority on the subject of industrial hygiene.

F. E. T.

REPORT TO THE SECRETARY OF STATE FOR THE COLONIES ON THE OUTBREAK OF PLAGUE IN THE GOLD COAST COLONY AND ASHANTI. By Professor Sir William Simpson, C.M.G., M.D., F.R.C.P., D.P.H. Published by the Crown Agents for the Colonies. 1925.

Sir William Simpson points out that until the first quarter of 1924 there had been no serious outbreak of plague since 1908, when there were 344 recorded cases in the colony, of which 300 were fatal. Of the fatal cases, 157 occurred in Accra and its neighbourhood. From 1908 to 1917 the Gold Coast was free of plague. In January, 1917, plague appeared at Ofako, in a village nine miles from Accra, and 39 deaths were traceable to this source. Unlike that of 1908, there was no obvious association with an epizootic of plague among rats. In December, 1917, nine deaths from pneumonic plague occurred in Axim, and there was a recurrence in this part in July, 1918. In July, 1919, one death was recorded in Accra.

Sir William further points out that in view of the position of the Gold Coast and its trade relations with countries infected with plague, its comparative freedom from plague may be considered fortunate. He considers that some of the immunity of the Gold Coast during these years may be attributable to not possessing any port which admits vessels which may contain infected rats alongside its docks.

A table is given showing the plague prevalence and deaths in 1922 and 1923 in countries on or near the West Coast. Much other interesting information is also contained in this very complete and very well-written report. It also contains many excellent photographs which vividly convey the sanitary and general conditions of life on the Gold Coast.

F. E. T.

Original Communication.

EPIDEMIOLOGICAL STUDY OF LEISHMANIASIS VISCERALIS IN SPAIN.

Report by Professor G. PITTALUGA,
University of Madrid.

(1) SINCE the year 1925 many hundreds of cases of infantile kala-azar or leishmaniasis visceralis have been observed and partly described. Further on [1] we give a bibliography of these cases, which, however, does not claim to be complete.

From my personal experience and data collected by my collaborators and pupils, one is bound to conclude that there exists in Spain (one may even affirm in the whole of the Iberian peninsula, as we shall see) a genuine endemic of leishmaniasis visceralis. This endemic is far from being localized or limited to the coast or the country near the shores of the Mediterranean. We know of more than a hundred local cases which occurred in the central and western provinces of Spain (Madrid, Toledo, Caceres, &c.). The epidemiological circumstances and ætiological agents of this disease make it, therefore, worth while to study it carefully in these surroundings.

Although cases amongst children of tender age predominate (from a few months to 10 and 15 years), we know of several cases of visceral leishmaniasis amongst youths and adults (15, 23 and 46 years). We prefer, therefore, and shall henceforth use on this account the term " Visceral Leishmaniasis " instead of the common designation of " Infantile Kala-azar."

(2) HISTORY.

The first cases of infantile leishmaniasis were observed and determined (through microbiological diagnosis by puncture of the spleen) in the neighbourhood of Tortosa (province of Tarragona) by my assistants Vilá and Torrademè in September, 1912. I went over this part of the country personally—it is highly infested by malaria—in the month of August of the same year. It is interesting, in my opinion, not only with regard to history, but on account of the demographical and epidemiological consequences which may be derived from them, to publish the means I used in order to induce the medical men of Tortosa and surrounding villages to share my absolute conviction as to the existence of leishmaniasis amongst the children of that locality. I had asked Dr. Torrademè, physician, of the village of Perelló (4,160 inhabitants, 20 kilometres from Tortosa) to make a retrospective investigation on statements made as to the causes of death amongst children in the civil registry of the town clerk's office of the village. I did not expect to find diagnoses of kala-azar; but, as the whole region is extraordinarily malarial and children suffering from malaria and enlarged spleen abound, one would expect that, in discovering in these records of mortality (causes of death) amongst children, some medical statements diverging from paludism and reminding one of the syndrome of leishmaniasis—for instance, " splenic anæmia "—we would be in possession of a serious argument in favour of leishmaniasis, that is to say, of an infectious and endemic disease, which could be clinically separated from malaria in a surrounding of endemic malaria notwithstanding the difficulties of a differential diagnosis. This reasoning was confirmed by the suspicions of the local doctors, in particular of Drs. Vilá and Torrademè, who for some time had been observing ailing children who did not react to quinine and whose characteristics of anæmia and splenomegaly did not entirely correspond to those of children infected with malaria.

The following are the results of the investigation [4] from January 1, 1904, to July 1, 1912: Different medical men who followed each other in Perelló had established, without any microscopic confirmation, for 42 cases of death (of which the majority were of children of less than two years; five between two and three years; one at the age of six) the following diagnoses:—

	Cases
Splenic leukemia	31
Splenitis or chronic splenitis	4
Hodgkin's disease...	4
Splenic anæmia	2
Pseudo-leukemic anæmia	1
Total	42

The same method of investigation had also been followed, almost at the same time (1913), by Vilá in Tortosa and by Martinez in Granada [5]. The two authors have published the records of children's mortality in several villages (Ametlla, Roquetas, Motril, Torvizcón, Sorvilan, Almuñecar, Darrical, Almegijar, Busquistar, Pitres, Beninar, &c.) during periods dating back to 10 and 15 years.

Both ascertained the same interesting fact, namely: everywhere, the physicians declared—the proportion being more or less high—cases of death in children, unmistakably due, by a deduction, a posteriori, to kala-azar infantilis.

This was more than a hint. Later researches have proved the accuracy of this reasoning. Torrademè—who at present (1925) directs the anti-malaria dispensary of Amposta-Aldea (Tortosa)—has recorded from 1914 to this date 52 cases of leishmaniasis, 17 of which were positive, as shown by microscopical examination after puncture of the spleen. Some of these cases were submitted, September 6 last, to the members of the Commission on Paludism of the Committee of Hygiene (Health) during their voyage of study in Spain. If we take in the village of Perelló the total number of supposed cases (1904-1912) and the number of those proved beyond doubt (1914-1925), we get an average of 5 cases a year for approximately 4,200 inhabitants. These 5 cases were children and their mortality has been 100 per cent. up to 1912.

Drs. Vilá and Torrademè also established (1913) the existence—in a small proportion—of spontaneous leishmaniasis in dogs in connection with this focus of visceral leishmaniasis among children. The study of the parasite (cultures, experimental inoculations, &c.) had been undertaken by us in 1913 in collaboration with Drs. García del Diestro, Vilá and others [6]. From

that date the observations have been multiplied successively in the provinces of Granada, Valencia, Barcelona, Tarragona, Castellon de la Plana, Alméria, Malaga, Murcia [7]. The puncture of the spleen, chiefly after the method of Caronia (prick without aspiration), has been generalized as a diagnostic method, according to the teaching of my school. At present it is practised by a considerable number of doctors in the villages.

In 1914 García del Diestro described the first case of infantile leishmaniasis in Madrid. At present we know of some 20 cases [8]. It is only during these later years that in the central and western provinces of Spain considerable centres of visceral leishmaniasis, chiefly infantile, have been detected, of which the most interesting is the focus of Talavera de la Reina (province of Toledo), where the director of the local anti-paludean dispensary, Dr. David Ortega, in collaboration with de Buen, Luengo and others, has succeeded in registering during two years 55 cases (all positive, as shown by the examination of the spleen).

In Portugal the first case of leishmaniasis was described by Diomisio Alvarez in 1910. It concerned a child, 9 years old, which had been splenectomized by the surgeon, Salazar da Sousa [10], apparently for tuberculosis of the spleen. Later on, up to the end of the year 1923 (I do not know exactly the posterior data), about 50 cases have been described, of which 45 per cent. concern males and 55 per cent. females; nearly all the cases, with the exception of one, an adult, studied in 1921 by Dr. Caeiro Carrasco [11], occurred in young children.

The most important centres of leishmaniasis in Portugal are situated in the low valley of the Tagus, on the outskirts of Lisbon, Monte Estoril, Santarem, Setubal, Silva. Cutaneous and mucous leishmaniasis (bouton d'Orient, American leishmaniasis) have often been observed in Portugal. Nearly all these cases had been imported from Brazil [12].

(3) General Statistical Data.

The cases of visceral leishmaniasis which have been traced or determined by diagnosis during the last few years are, of course, much more numerous than those traced in former years. General statistics of observations published since 1912 do not, therefore, give a true impression, proportional to the importance of the endemicity.

The figures are as follows [13]:—

(*a*) Cases of visceral leishmaniasis diagnosed by puncture of the spleen (presence of parasites):—

Province of	Barcelona	7
,,	Tarragona	53
,,	Castellon	78
,,	Valencia	58
,,	Alicante	8
,,	Murcia	3
,,	Almeria	9
,,	Malaga	1
,,	Granada	34
,,	Cordoba	4
,,	Madrid	21
,,	Toledo	55
,,	Caceres	11
,,	Badajoz	1
	Total	343

(*b*) Cases of infantile leishmaniasis where the diagnosis was based on clinical data (characteristic of splenomegaly), hæmatological[1] or therapeutical data (efficacy of treatment by stibiated[2] preparations) [14].

Observations of Dr. Torrademèl (Tortosa) ...	35
,, Dr. Comin (Valencia)	235
Various observations	50
	320

We shall, of course, retain as a basis for our later epidemiological study the figures of those cases only where the diagnosis was founded on microbiological evidence (343 cases have come to our knowledge). But we have added the figures of the cases where the diagnosis was established by clinical methods, because in Spain practitioners of great merit and undeniable experience hold that it is nearly always possible to furnish this diagnosis. We shall later discuss on this opinion to which I do not ally myself for scientific and pedagogical reasons.

(4) Age and Sex of the Patient.

As regards age one may draw up the following table:—

Cases of leishmaniasis under 6 months		11
,, ,,	1 year	36
,, ,,	2 years	120
,, ,,	3 ,, ...	58
,, ,,	4 ,, ...	48
,, ,,	5 ,, ...	35
,, ,,	6 ,, ...	16
,, ,,	between 7 and 10 years	3
,, ,,	between 10 and 12 years	1
,, ,,	between 12 and 15 years	2
,, ,	at 23 years	1
,, ,,	at 46 years	1
,, ,,	at unknown age ...	11
	Total ...	343

The part sex plays is of much less importance. The cases may be divided as follows: 43 per cent. males, 57 per cent. females [15].

(5) Geographical Distribution.

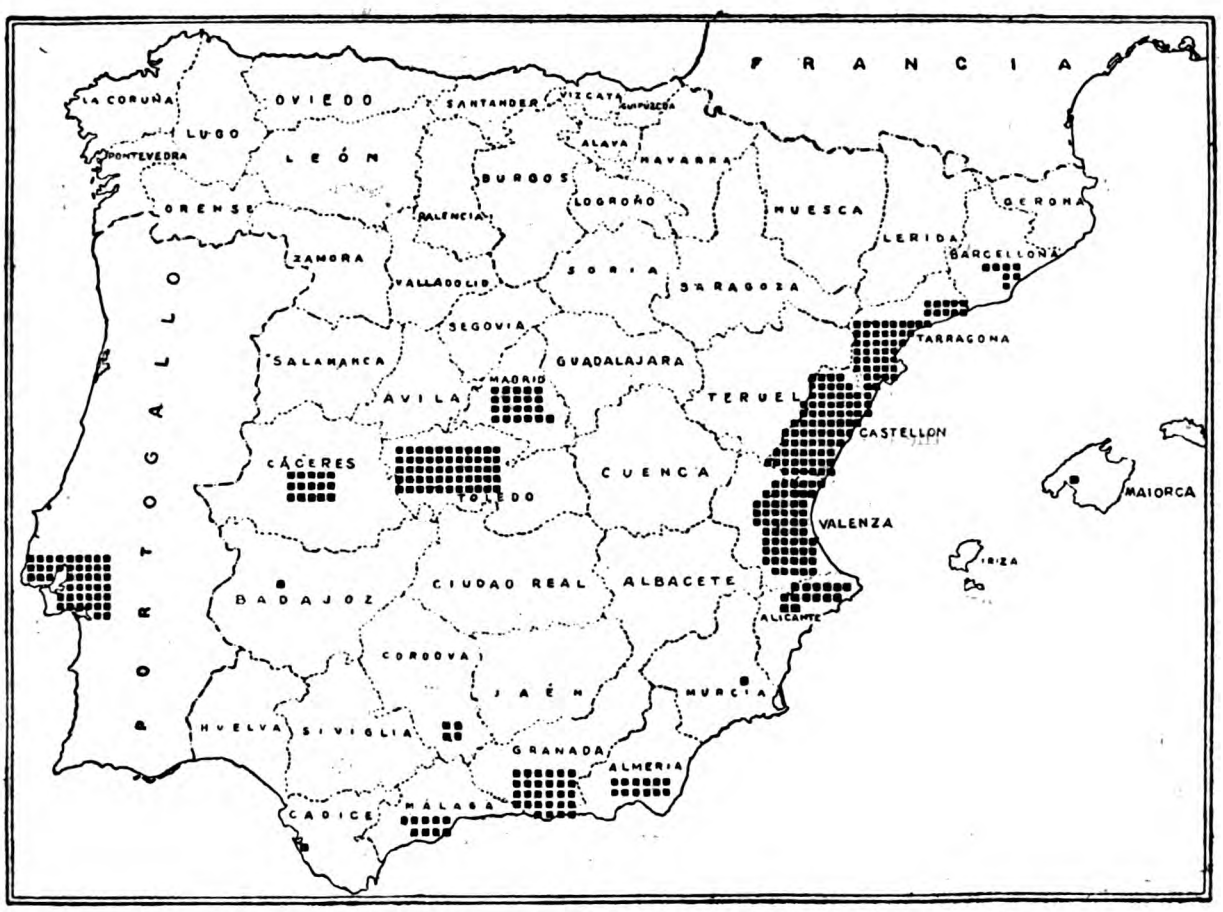
By examining the above data (§3) the following conclusions may be drawn, *grosso modo*: (*a*) important hotbeds of visceral leishmaniasis exist along the oriental shores of the Mediterranean, with two predominating centres in Tortosa and Valencia; (*b*) those of the provinces of Alicante, Almeria, Murcia, Malaga seem to be smaller; (*c*) important foci exist on the western shores of the Mediterranean and in Andalusia (Granada, Cordoba); (*d*) finally, extremely interesting are the centres of infection existing in the western and central parts of Spain, where about one hundred cases have been registered, mostly in the province of Toledo (Talavera de la Reina), and even in Madrid, in Caceres, &c. (See map, page 389.)

Neither a site nor a single case has as yet been reported above 42° of northern latitude. The centres situated highest to the north are those of Barcelona and Reus, situated near 41° parallel.

[1] Leucopenia. [2] Antimonial.

As to altitude, it must be stated that most of the localities where the cases observed originated are situated in the plain, near the coast or at a height of not more than a hundred metres above sea level, with the exception of the villages in the Sierra de Gredos (Villanueva de la Vera, &c.), in the province of Caceres, observed by Dr. de Buen (1922), afterwards by Drs. Luengo, David Ortega and others (1923). These villages are situated at a height of about 300-450 metres above sea level. Certain villages of the southern part of the province of Valencia, as Onteniente, and the localities bordering the province of Alicante, as Cocentaina, where Naravra Huesca, even Castilla la Veija and Aragón), remain for the present unaffected by the disease, in spite of all reserves I have to make on the subject.

It must not be forgotten that the detection of the cases of leishmaniasis is part and function of medical culture and of appropriate professional training. We do not allude here to the northern province just mentioned, where the effect of the epidemiological agents of leishmaniasis is probably neutralized by the climate. It is, however, a fact that the centres of disease which up to the present have been traced were discovered where a good school of pædiatrists



Distribution of cases of leishmaniasis visceralis (infantile kala-azar) in Spain (1925).

Dr. Comin, children's specialist in Valencia, discovered cases of leishmaniasis, are also placed at heights varying between 250 and 400 metres. It must be kept in mind that we know of 20 local cases in Madrid in children born and bred in the capital or its suburbs (Ciudad lineal), viz., at an altitude of more than 650 metres.

It is true that a certain distribution as to climate, in connection with altitude and latitude, can be noted as regards the geographical distribution of visceral leishmaniasis in Spain. Thus the northern provinces (the whole of Galicia, Asturias, the provinces of Bilbao, Santander, San Sebastian, Vittoria, had striven to acquire the necessary knowledge as to local infantile epidemiology, or in the villages, where young physicians had exercised their art, inspired by our school of parasitology, or in those parts of the country where our organization for fighting paludism had sent its technical staff. This means, in my opinion, that, should one search elsewhere, one would, under similar climatic conditions, discover new cases; the distances which at present separate the important known centres of the disease would disappear or would be greatly reduced and the present aspect of the geographical distribution of visceral leishmaniasis, with its fragmentation and

localization without sufficient reasons, would be considerably altered.

(6) The Hotbeds of Leishmaniasis.

Which are indeed the characteristics of the existing centres of leishmaniasis? What is peculiar to them and what do they have in common? In what way do they differ from the neighbouring localities, where no cases of this disease have been encountered?

In order to answer these questions we shall have to examine more closely the conditions of living of the population, chiefly of the families who live in the midst of the hotbeds of leishmaniasis.

The result of this examination will show that the conception of the great centres of leishmaniasis such as they appear when examining the present geographical distribution of the disease, does not hold out against scrutiny. Evidently there exist centres of visceral leishmaniasis. Leishmaniasis is perhaps essentially a disease of small, localized centres, even limited to the home alone, as some observers (for instance, among the Italian school, Jemma and his collaborators, and in Spain, Camacho Alejandre, Torrademè, de Buen) [16] have maintained. But these small centres (small towns, suburbs, farms, &c., or villages separated from other villages, safe from disease) have precisely nothing in common with the great centres which now appear on the map (the focus of Talavera de la Reina, in the province of Toledo, or the centre of Tortosa or Valencia). To sum up, I consider the last named two as artificial centres. They exist owing chiefly to the activity of a circle of professional culture which stirred a current of investigation around them resulting in the detection of the sick. These large centres have probably nothing or very little to do with the real topography of the cases of leishmaniasis, neither houses nor localities infested with it; such a topography ought first to be established before speaking of hotbeds of the endemics, in the real meaning of the word.

(7) Social Conditions.

The sick children belong in a great majority to poor families. But many cases apply to better people, or even to middle-class families in excellent economical conditions. The case of a girl, 11 years old, who lived in a villa in Ciudad lineal (suburb of Madrid) and belonged to a middle-class family—her diagnosis was established in May, 1924 (puncture of the spleen) by Dr. de Buen; a case studied and treated by myself and my assistant, Miss Gonzalez Barrio (1921); a case observed by Dr. David Ortega in Talavera; the case of a child, a cavalry officer's son, sent to me for consultation by Dr. Camacho Alejandre (1923), and other cases prove that social conditions, as far as they depend on a good economic situation of the family, do not exclude infection. But the hygienic conditions of life, chiefly those of rural or semi-rural dwellings (with a garden, poultry yards, cattle, &c., water-closets in bad condition, or non-existing, &c.) are of a primary importance. Even in the cases just mentioned, which concerned well-to-do families, such defects are to be found. The small site of infection of Ciudad lineal, near Madrid (where several cases originated), is characteristic in this respect; it is a closed-in district, formed by small houses or villas, with their own garden, a poultry yard, &c. Other local cases in Madrid originate in other populous districts, situated on the outskirts of the town, where the type of dwelling is already rural.

With regard to some of the patients living in town (in one case, a house in the centre of Madrid), we are certain that infection was contracted in the country (province of Almeria) [17].

(8) Canine Leishmaniasis and Domestic Centres of Visceral Leishmaniasis (Houses of Kala-azar).

The coincidence of certain centres of spontaneous leishmaniasis in dogs, with cases of visceral leishmaniasis in man, has been ascertained in Spain since 1913. Vilá and Torrademè have found infected dogs in the neighbourhood of Tortosa in a proportion of 4 positive cases for 65 dogs examined (6 per cent.) [18]. Camacho Alejandre discovered a still higher proportion (22 per cent.) for 7 dogs in direct contact with sick people (dogs belonging to houses of kala-azar). I have endeavoured myself, with Dr. García del Diestro, and later with Miss Gonzalez Barrio and Mr. Campuzano, Professor of the Veterinary School in Madrid since 1914, to trace dogs with leishmania in connection with the cases of leishmaniasis on the outskirts of the town of Madrid, without any positive result, however. Campuzano has examined some 15 dogs, more or less in contact with human cases, and over 200 dogs taken at random in Madrid and in the suburbs, all with negative results (spleen and liver). The veterinary inspector of Valencia, Trigo Mezquita, published in 1916 the result of an examination of 313 dogs, with 3 positive cases. Lately, de Buen took up these researches in the zone of Caceres, but without any positive result.

It must be admitted, nevertheless, that a methodical investigation on dogs, pursued in localities infested by human leishmaniasis, especially kala-azar-infected houses, has not been attempted and is urgently needed in a country like Spain, where the dog is constantly and intimately associated in rural surroundings with domestic life. Some observers—for instance, Camacho Alejandre (Almuñecar, Granada)—insist on the importance of this cohabitation and the consequent formation of small foci of human and canine leishmaniasis, both occasionally appearing isolated, viz., separated from each other in the same locality.

(9) The Parasite.

The parasite, pathogenic agent of visceral leishmaniasis, observed in human beings in Spain, does not differ from the type *Leishmaniasis infantum*. Its morphological and biological characteristics in the organs of the sick child (spleen, liver, bone-marrow), in cultures and experimental inocula-

tions (dogs), have been described since 1913 by us and our collaborators, García del Diestro, Vilá, Gonzalez Barrio, &c., by Fernandez Martinez, of Granada, by observers of the School of Barcelona (Sayé and Alomar, Pi Suñer, Carrasco, Roiy, Martinez Vargas and others), by Gomez Ferrer, Aguilar Jordan, Comin, and Peset in Valencia, by de Buen [20]. We refer the reader to these works and to the summary of the subject in my book, "Diseases in Hot Countries and General Parasitology" (1923).

The leishmania of dogs, whether spontaneously infected or experimentally inoculated with human virus, nearly always affect a slightly elongated form, pear- or egg-shaped, with a longitudinal diameter of two microns, or more, and a transverse diameter not exceeding 2 microns. One very seldom finds in the smears from dogs the round shapes with large nuclei (trophonucleus) and with rounded punctiform blepharoplast, which are met, chiefly when infection is recent, in the organs of children—in particular in the perithelial cells of the hæmohistiocytarian type (hæmohistiocytes and hæmohistioblasts of Ferrata) [21]. But the fact that this morphological character (besides being of small importance, as the pear-shaped forms are equally met with in infantile leishmaniasis) appears both in the leishmania of spontaneous infection of dogs, as in the parasites of human stock experimentally inoculated into dogs—seems to prove that their species does not differ, as least as far as their structure and morphology are concerned.

The leptomonas (flagellated forms) in cultures (on blood-agar N.N.N.) are identical.

In the parasitized organisms we have met leishmania also in peripheral blood, chiefly in the leucocytes (monocytes and neutrophilic granulocytes) [22]. These parasites are nearly always round with slightly elongated corpuscular blepharoplast. I consider these shapes as an indication of recent infection. Even when met with in the endothelial or perithelial cells, or in general in the reticulo-endothelial system of the organs, they are probably in relation with the hæmatic phase of the parasite, which seems to be demonstrated, too, by their much more reduced number in the interior of the cytoplasm of the elements where they lodge, as compared with the number of parasites of the pear-shaped type, or, in general, of the type with elongated stick-shaped blepharoplast. If I insist on these observations it is because they are related to the problem of the parasite's introduction into the organism of men and mammals and, more strictly, to the structure and morphology of the parasite in the initial periods of its development, after inoculation. This question is directly connected with the aspect of the parasites at the time of inoculation, in the insect or insects which may be incriminated as the intermediary hosts, or as the carriers of the virus of leishmaniasis.

(10) Transmission of Visceral Leishmaniasis. Carrier Insects and Receptacles of Virus.

Our present knowledge as to the transmission of visceral leishmaniasis results from the critical examination of the following hypotheses:—

(*a*) Direct or indirect transmission of the virus from the intestinal mucous membrane, chiefly by intestinal worms.

(*b*) Transmission by fleas of men and dogs.

(*c*) Transmission by bugs.

(d) Transmission by hæmatophagous nematocera (Culicidæ) or brachycerous diptera (Tabanidæ).

(*e*) Transmission by phlebotomes.

We shall here deal summarily with the data concerning these different hypotheses resulting from personal experience and that of Spanish investigators.

(*a*) The direct transmission of the virus by the intestinal canal—a theory which, formerly defended by Donovan, and more recently, concerning Indian kala-azar, by Mackie, by Archibald and others—cannot be admitted in most of the cases of leishmaniasis infantum, and this, in our opinion, for the following reasons:—(1) In cases concerning children of tender age, for instance, 3 months, fed exclusively at the breast of the mother, it is difficult to imagine an infection by resistant forms of leishmania, which ought to proceed from the bowels of a sick person, or from a carrier of virus, which should have contaminated the water or an object having come in contact with the infant's mouth. (2) The forms of leishmania known to us, outside the organic internal medium, namely, the leptomonas forms of cultures, are extraordinarily sensitive to all contamination of the soil by bacteria in general, as we have ascertained with all the species (human and canine) inoculated by us; accordingly, it is difficult to assume that they are apt to multiply or to remain in the intestinal canal, preserve their vitality, and finally be evacuated. It is, moreover, a hypothesis which, for many other reasons, does not withstand further criticism. The indirect transmission by inoculation through the intestinal helminths—which, by the way, has been discarded lately in India by the researches of the commission presided over by Christophers [23]—is contradicted in Spain by the following facts: (*i*) There are no nematode parasites (the only helminths which could be incriminated as inoculators) to be found in the intestines of infants of low age, viz., at an age when leishmaniasis is most frequent. (*ii*) A very high proportion of elder children in our rural districts (between 3 and 15 years), and adults who harbour intestinal helminths (Oxyuris, Ascaris, Trichocephalus) do not show any symptoms of leishmaniasis. (3) Negative result as to the presence of helminths' eggs in excrements examined of several children suffering from leishmaniasis. (4) No eosinophilia in nearly all the cases of leishmaniasis observed in Spain and whose leucocytarian formula has been established (some hundred cases) [24]. (5) No coincidence between the larger foci of ankylostomiasis [25] and part of the actual foci of leishmaniasis (Madrid, Talavera de la Reina, &c.).

(*b*) Transmission by Fleas.—The hypothesis sustained by Nicolle (1908) and defended later with such tenacity by Basile—is still the one which seems to rally, in Spain, the greatest number of adherents. Since 1913 Vilá and Torrademè have endeavoured to study the habits of the fleas of dogs (*Ctenocephalus canis* and *Pulex serraticeps*) in

their connection with children; Vilá even examined the fleas of infected dogs. We have made during the years 1913-1914, in the Institute of Hygiene Alfonso XIII, a series of observations on fleas of dogs, experimentally inoculated with the virus of the infantile leishmania of Tortosa. The objection, resulting from Wenyon's works on the herpetomonas of fleas, remains still the most serious difficulty for resolving the question of an evolutionary phase of the leishmania in the intestines of fleas. From the protistological point of view the problem is not modified. Nevertheless, there are reasons of an epidemiological order, in our opinion, which neither plead in favour of the hypothesis, the dog as a receptacle of virus—nor of the other—the transmission of the virus by the fleas of either dogs (*Ctenocephalus canis*) or men (*Pulex irritans*). This does not affect the problem of identity between the viruses of human visceral leishmaniasis (kala-azar infantum) and leishmaniasis canis, nor does it concern the possibility of an experimental inoculation. The confusion created between these two problems has been prejudicial to their solution. It is quite possible, and I am of the opinion that the parasite is the same; but it is very likely, too, that the intermediary host or transmitting agent of leishmaniasis is not an ectoparasite, as strictly and constantly associated to the life of the dog, as the *Ctenocephalus canis*. Indeed, should that be the case, how would one explain the great difference which exists in Europe and in Northern Africa between leishmaniasis of dogs taken at random and leishmaniasis of dogs proceeding from endemic foci or houses of kala-azar infantum? I need not recall here the observations of Coronia and Di Giorgio, who discovered in Palermo only a single positive case for 1,005 dogs, picked up in the streets and examined by them. Jemma also obtained, a few years ago, a negative result for 300 dogs examined, from the same place. Now the same author found two infected dogs out of seven examined in the suburbs of Palermo, which are foci of leishmaniasis infantum. The high percentage observed by Basile near Messina (in Bordonaro)—the highest known (81 per cent. for dogs examined)—is in relation to one of the most important hotbeds at present known (Gabbi, 1909). I shall not reproduce here other existing statistical data on canine leishmaniasis in Italy, Greece, Russia, Tunis, Algeria, Morocco, Dekar, &c. I only wish to emphasize one fact, i.e., in Spain all the data collected, up to now, lead to the conclusion that spontaneous leishmaniasis of dogs taken at random (street dogs, dogs in the country) seldom occurs, while the proportion grows if one takes dogs which are in contact with human cases of kala-azar. An observer as careful as Dr. M. Vilá (of Tortosa) did not find a single animal infested with parasites in 43 dogs examined (spleen, liver, bone-marrow). Later a dog from the village of Aldea and another from Camartes, foci of leishmaniasis infantum (Torrademè and Vilá, 1913), gave positive results. We have already mentioned elsewhere (§8) the data furnished by Messrs. Torrademè, Camacho Alejandre, Campuzano, Trigo Mezquita, de Buen. From the total of these researches the following figures can be deduced:—

	Number of dogs examined	Number of positive cases	Proportion per cent.
(1) Dogs taken at random ...	558	3	0·54
(2) Dogs from houses with leishmaniasis	52	6	11

It must therefore be admitted on the one hand that in those localities where human cases of visceral leishmaniasis occur and where, on the other hand, the proportion of infected dogs is high, there intervenes a factor which must not be exclusively and intimately associated with the life of men and dogs, but which, moreover, is in connection with some local circumstances. This deduction can still be supported by other facts: there certainly are cases where it is extremely difficult to establish a relation between the existence of human cases and the presence of the dog. With my former assistant, Miss Gonzalez Barrio, we have seen a young patient, the daughter of a railway official, who had never left Madrid and did not possess a dog. In Naples for 110 observed cases (clinic of Professor Jemma) Javarone affirms to have succeeded only ten times in establishing the presence of dogs in the home of the sick person. I should like to recall the case reported by Jemma [26] of a little girl 17 months old, living in a suburb of Palermo, in the house of wealthy parents who observed the precepts of hygiene. More than two years before, that is to say, previous to the birth of the patient, an elder brother died of leishmaniasis. At that time a dog was kept in the house; that dog had been examined by Professor Jemma. It carried no leishmania. Notwithstanding this the father, alarmed by the doctor's opinion, did not want to continue keeping his dog. The animal was therefore no longer in the house when the girl was born, and all precautions were taken by the family to avoid the least contact between the baby girl and dogs. The girl, nevertheless, contracted kala-azar. One may also quote the following observation: Contrary to the fact that the proportion of infected dogs in certain centres of human leishmaniasis is higher than among dogs taken at random, one finds certain centres (houses, small towns) of infantile kala-azar where dogs do not carry the virus.

We arrive then at the following conclusions: (1) The dog does not seem to constitute a receptacle of virus—independent of the foci—of human leishmaniasis. (2) The parasite does not appear to be transmitted by an insect, as intimately associated with the life of the dog as the *Ctenocephalus*, because in such a case one would probably observe a much higher proportion of disease among dogs in general. (3) The infection of the child is not always related to the presence of dogs. (4) The child and the dog probably get infected in certain places where there exists, under favourable circumstances, a common factor of infection, probably an intermediary host not as intimately connected with the life of the dogs as are the fleas, but who could infect (by stings or other means) the child and the dog as well. The in-

fection of the house cats, under these circumstances, is also possible. Vilá (of Tortosa) found a sick cat (sent to us in 1914); so did Sergent, Lombard, Gurlichini and others. These conclusions could be admitted, should one incriminate chiefly the *Pulex irritans* (common fleas of men) and not the fleas of dogs (*Ctenocephalus canis*). Now, the ubiquity of these ectoparasites is far from being equal in the two hosts.

In Spain, Italy and generally in Mediterranean and subtropical countries, fleas of dogs are found frequently on men. On the contrary, fleas of men are found in dogs under much more accidental circumstances. One ought to admit, therefore: (*a*) either that canine leishmaniasis is due to a different virus, transmitted by the *Ctenocephalus* to dogs alone: (*b*) or that the *Pulex irritans* is the only real transmitting agent of the leishmania.

One may invoke against the first hypothesis: the scarceness of leishmaniasis among dogs taken at random; the high proportion of the disease in centres of kala-azar infantum; the morphological identity; the experiments of Nicolle, Basile, &c. (inoculation of the human virus into dogs); those of Novi, performed with cultures; the results attained with the two kinds of fleas by Basile, &c. Against the second hypothesis I plead the conclusions arrived at by such authors who succeeded in transmitting the human virus experimentally to dogs, chiefly through the *Ctenocephalus*, as much as the relations existing between the fleas of men and dogs, &c. I think, nevertheless, that this question ought to be taken up again, without canine leishmaniasis being allowed to trouble our mind overmuch. The observations of La Cava, Visentini, Basile, &c., on *Pulex irritans* (fleas of men) infected on dogs are decidedly suggestive. We have to start from the conception that the dog is not the receptacle of the virus for men. As for kala-azar in India, the non-existence of spontaneously infected dogs (or their scarceness) has done much to free the mind of the epidemiologists from some preconceived ideas. On the whole we cannot reject the hypothesis of the fleas; we submitted it to critical analysis; we think that it ought to be taken up again by an experimental and parasitological study, which should not be overruled by Nicolle's categorical affirmation that infantile kala-azar is a natural infection of the dog transmittable to the child [27]; this affirmation, which has opened the path to most important investigations and has given so many fruitful results, does not seem any longer to agree with the actual state of our knowledge.

(*c*) Transmission by bugs.—The hypothesis sustained by Patton and others as to kala-azar in India appears in Spain to be contradicted by the following facts: (1) The very filthy urban centres where bugs abound, as it happens in some houses with a very considerable number of tenants (" casas de vecindad " in the suburbs of Madrid, with five hundred, even a thousand, people living in the same block, comprising from one hundred to two hundred small bedrooms), have not, up to the present, contributed any cases of kala-azar. (A serious investigation as to this matter remains to be undertaken). (2) Some houses of kala-azar, in villages even, are very clean and have no bugs. (3) In some houses healthy children generally live and sleep with one or several of their younger brothers and sisters, ill with leishmaniasis, or even with sick adults; now, the habits of bugs, their voracity, &c., are such that it is difficult to conceive, under these circumstances, an inoculation limited to certain individuals only. It is well to recall here that some of the foci of leishmaniasis coincide, for instance in the Province of Caceres, with cases of recurrent fever with " spirochæte recurrentis " which have been traced during these last years by Mr. de Buen and others. They concern spirochætosis transmitted by bugs; and we know that the *Cimex lectularius* can be the transmitting agent. In any case this assertion gives one an indication as to the abundance of the domestic ectoparasites.

(*d*) The part played by the hæmatophagous diptera, belonging to the species of Culicidæ, Tabanidæ and Muscidæ, must, in our opinion, be taken but little into account, save, perhaps, as regards the transmission of cutaneous leishmaniasis, for which Cardomatis has incriminated flies.

(*e*) Transmission by the Phlebotomes.—The hypothesis advanced in 1914 by Sergent, Lemaire and Senevet, concerning the transmission of cutaneous leishmaniasis by the phlebotomes and the possibility of a receptacle of virus (cold-blooded vertebrate) has induced us, in collaboration with de Buen, to study the Spanish phlebotomes [28]. Since 1916, thanks chiefly to Mr. de Buen's personal researches, we know to a certain extent the geographical distribution and localization of four species of phlebotomes in Spain:—

Phlebotomus papatasii (Madrid, Escorial, Navalmoral de la Mata, Talavera de la Reina and surroundings, Granada, Malaga, Tortosa, Palma de Mallorca, and other places);

Phlebotomus legeri (*perniciosus*) (Malaga, Palma de Mallorca, Granada, Araujuez, Huelva);

Phlebotomus minutus (Navalmoral de la Mata and surroundings, Province of Caceres; Granada, Malaga, Palma de Mallorca);

Phlebotomus sergenti (Navalmoral de la Mata Granada).

The biology and habits of these small diptera, better known since the excellent works of Grassi, Newstead, Summers and Larousse, are most interesting from our point of view, as they coincide with several epidemiological characters of leishmaniasis in general and of visceral leishmaniasis in particular.

The demonstration given by Parrot, Sergent, Donatien and Béguet as to the possibility of inoculating the leishmania of oriental sore into the skin of men through scarification with infected phlebotomes (1921) has still further increased the interest of these investigations. Recently (1924), in the works of Knowles, Smith and Napier, undertaken in India under the direction of Christophers, the phlebotomes are considered as the transmitting

agents of *Leishmania donovani*, of Indian kala-azar. The experimental results gained so far are highly instructive, and they compel one to examine seriously the same possibility with regard to European visceral leishmaniasis.

The phlebotomes abound in Spain all through the summer in rural or semi-rural houses of certain localities. They are even met with in towns (Madrid, Barcelona), but in garden districts only, where certain conditions peculiar to country surroundings (as old walls, poultry yards, &c.) prevail. They are sometimes very numerous in bedrooms, but they are generally found hiding in dark places, in small untenanted rooms, &c. At all events they concentrate in certain farms, houses, cottages, huts and hovels, which they appear but seldom to leave. One meets with sporadic foci of phlebotomes; they are plentiful in some places, and close by in the same locality there are often none to be found. This fact is most striking for its coincidence with the distribution of kala-azar.

In connection with the phlebotomes it is necessary to examine the reptiles on which they feed for preference.

In Spain, in localities where phlebotomes are found, the small saurians commonly called tarante or geco (*Platydactylus mauritanicus*) are very frequent. According to Sergent, Lemaire and Senevet, these small saurians constitute a receptacle for the virus of cutaneous leishmaniasis. S. de Buen has ascertained the presence of these reptiles in almost all the localities where the phlebotomes dwell and where visceral leishmaniasis has also been observed. Yet he has not succeeded in tracing platydactyli, carriers of parasites, comparable to the leishmania. My resident pupil, Mr. Elosegui, has examined during these last months the blood and organs of fifteen platydactyli in Olivenza (Badajos) with negative results. These investigations, so far bearing only a tentative character, ought to be continued with method and to operate on a more copious material for study. I have examined personally a hundred phlebotomes (*P. papatasii* and *minutus*) caught in Talavera de la Reina in houses where cases of visceral leishmaniasis had occurred, by Mr. Gil Collado, entomologist of the Malaria Commission, and Mr. David Ortega. I found not anything, either in the intestinal contents or between the coat cells of the alimentary canal, which might recall a known form of the evolution of leishmania.

My collaborators and myself had neither the time nor the means to pursue these observations systematically, or to attempt an experimental study.

We believe the following to be essential: (1) The breeding of phlebotomes in the laboratory; (2) to feed these phlebotomes on dogs, bearers of leishmania; (3) to transmit, through the stings of these phlebotomes, the infection to young healthy dogs; (4) to try the same experiment with human virus; (5) to feed the infected phlebotomes on platydactyli and sacrifice the latter successively at periods more or less remote from the time of inoculation; (6) to study, by histological and cytological methods, the possible evolution of the leishmania, whether of human or canine stock, in the alimentary canal of the organs of the invertebrate. It is a very arduous task which requires financial means which we, unfortunately, do not possess.

(11) Visceral Leishmaniasis and Cutaneous Leishmaniasis in Spain.

Observations on oriental sore have been published in Spain (Granada, Malaga, Almeria) since 1913 by Camacho and Fernandez Martinez (microbiological diagnosis. Numerous cases, clinically diagnosed, have been brought to our knowledge by physicians of the southern coast of the Mediterranean. We cannot furnish at present any data favourable or contrary to the hypothesis of immunity from visceral leishmaniasis brought about by cutaneous leishmaniasis.

(12) Clinical Syndrome and Evolution of Visceral Leishmaniasis in Spain.

Some ten years ago only very serious syndromes were observed here. Subsequently sick people were discovered, chiefly children, finding themselves, if not in the initial, at least in the slightly advanced stages of the disease. Those of our practitioners who work in localities infested with kala-azar easily diagnose leishmaniasis—and even this in districts with intense endemic malaria—by the paleness of the skin; by irregular fever with multiple remittances during the day; by the precocious and very accentuated splenomegaly; by the anatomical characters of the spleen, which distinguish it from the dilated spleen of malaria. For a long time we have insisted on the fact that there are many benign cases of kala-azar of very slow evolution, the little accentuated syndrome of which has to be traced and established by exclusion and the diagnosis of which ought to be confirmed by a microbiological examination of the spleen. I believe that the evolution of the disease in a great many cases which we ignore, or which we diagnose at a very advanced stage in children of 8, 10 and even 15 years (see § 4) or in adults, is much slower than we think. We probably only notice the cases with a malign or rapid evolution, or, on the whole, the grave ones. There is no doubt that when we get to establish a hereditary taint in the child, or an indirect and independent cause of less resistance, the leishmaniasis presents a more serious character and does not yield, or yields much less, to the action of compounds of antimony (stibio-resistance). We have had some striking cases, of which one (a child of 7) has been followed by all my collaborators for more than two years. This child, whose development was obviously arrested, was probably heredo-syphilitic. It had two or three successive relapses, and died, in spite of the most intense and careful treatment. Miss Gonzalez Barrio, in a remarkable case of stibio-resistance, which I had diagnosed four years years ago by puncture of the spleen, found the Wassermann reaction positive, not only in the child but also in the mother (who had had miscarriages).

(13) Diagnosis and Tracing of the Sick.

The fundamental basis for the study of the epidemiology of leishmaniasis is the tracing of the sick and the diagnosis of their illness. We have already clearly expressed our view concerning the artificial nature of the foci at present existing in great centres of leishmaniasis. They are all related to the existence of spheres of specialized medical science, or due to the presence of doctors particularly devoted to their task or to schools of parasitology or pediatry. We are absolutely convinced of the necessity to intensify the active influence of these elements and we think that by so doing a considerably greater number of cases of leishmaniasis will be detected: thus the true localization of the illness will be attained.

Our school has always insisted on the necessity of the parasitological diagnosis, and we have succeeded in introducing spleen puncture as an elective process, indispensable for the microscopical diagnosis, even into rural districts. In the large towns or suburbs the doctor in charge of the Municipal Services of Assistance are already accustomed to direct suspicious cases to our laboratories to have the puncture applied. I agree with Nicolle and Jemma in advising puncture of the spleen, and prefer the method for practical reasons and the positive result it furnishes to any other means of microscopical investigation of leishmaniasis.

A certain tendency has manifested itself recently with the pædiatrician and in certain rural districts towards giving a decisive importance to the clinical diagnosis and even denying the necessity of a microbiological confirmation of the diagnosis in the case of infantile kala-azar. Thus, for instance, Comin, assistant professor of pædiatrics in Valencia, a friend and old pupil of mine, states as proved cases of leishmaniasis during the last five years, 286 cases, observed by him in the province of Castellon, 43 in the province of Valencia, and eight in the province of Alicante. But, of the total of these 337 cases, only 102 were diagnosed microbiologically by spleen puncture, in collaboration with Professor Peset. It is true that Comin recommends, when resuming the conclusions of his work, the application of splenic puncture, though he thinks that an exact diagnosis can be established clinically.

The same opinion is upheld, even with more tenacity, by our friend and collaborator, Dr. Torrademè, who practises in Perello, near Tortosa. He believes the puncture of the spleen to be sometimes dangerous. Torrademè has carefully established all the differential characters between infantile kala-azar and children's malaria, and he maintains that the clinical diagnosis suffices.

We cannot accept that opinion. Even if we admit that the children affected by kala-azar have indeed a typical facies, even if we take into account the anatomical characters of the spleen of kala-azar which present nearly always a very pronounced notch on its antero-interior edge, as a consequence of the organ's precocious sclerosis, we, nevertheless, insist on the necessity of controlling the clinical diagnosis by the search for parasites. Spleen puncture is a trifling operation which in most cases causes no inconvenience. Finally, from the epidemiological point of view, it is possible to rely only on cases where the presence of the parasites has been proved.

The hæmatological and serological data are interesting (Brahmachari's and Napier's reaction, &c.), but the only alteration observed in a very high percentage of cases, and which really guides the clinical practitioner, is leucopenia.

(14) Efficacy of Treatment and Statistics of Mortality.

The treatment by antimony, in particular by the emetic (double tartrate of antimony and potassium or sodium), is very efficacious. In Spain the organic preparations of antimony have been much used (stybenil, Leyden 611, and Bayer 211 and 212, &c.). Comparisons between the results obtained by these different remedies have been established chiefly by David Ortega in Talavera de la Reina, who has observed and treated 55 cases of leishmaniasis during the last two years. The aggregate therapeutical results he obtained are the following: 33 patients may be considered as cured (60%); 14 patients died (24·5%); 9 patients are under treatment.

Torrademè, in Tortosa, believes he has obtained 7 cures on 11 cases treated with stybenil (= 63%).

Comin, in Valencia, has obtained less favourable results: 196 died out of 252 sick treated = 77%: 56 cured = 23%.

In my opinion such a difference is due rather to the therapeutical methods employed than to the system of moving dispensaries, which do not permit the observance of the sick with the assiduity and regularity demanded by the treatment, and above all, to the delayed diagnosis which had been established at a very advanced stage of the illness.

The observations of the Madrid pædiatrists, of de Buen, Luengo, Iglesias and others in the province of Caceres, and my personal investigations give figures approaching the result of Ortega in Talavera.

These therapeutical results, which Jemma and his collaborators (who attained the total of 85% cured) have surpassed, are very important from the prophylactic point of view. A parasitic illness of the type of an intermediate insect vector (which is very probably the case in kala-azar) requires always, as a means of contention, complete treatment of the virus bearer.

But it is particularly important to persuade the doctors not to undertake the specific treatment without the confirmation of the diagnosis by microbiological examination.

(15) The Probable State of the Present Endemic of Visceral Leishmaniasis in Spain.

The considerations just exposed concerning the reasons which provoked the appearance of what we

call " artificial hotbeds " of leishmania, at present known in Spain; their existence in provinces, even very distant from the coast; the progressive increase of the diagnosed cases in the course of these last years; the detection, almost daily, of sick people in the suburbs of large towns, like Madrid—lead us to the following conclusion: the cases of visceral leishmaniasis are much more frequent than they at present appear to be; we have to deal with a real endemic which has contributed in a large measure to infant mortality; a part, at least, of the forms of anæmia, pseudoleucæmia, splenomegaly, anæmia or atrepsia, which figure as causes of children's mortality must, indeed, be ascribed to leishmaniasis. The organization of a series of epidemiological inquiries and the application of preventive measures by the State and Sanitary Institutions, in general, impose themselves in Spain, as well as in the other Mediterranean countries.

(16) Plan of Work.

We think that, first of all, three inquiries have to be carried out.

(*a*) One of statistics, which should comprise a detailed revision of the declarations as to the causes of death in children in all the villages, towns and districts situated in climatological conditions similar to those of the localities where up to the present day cases of leishmaniasis have been ascertained;

(*b*) An inquest of the clinical and microbiological type directed by specialized practitioners. These should take as a basis for their investigations the different centres of research around which the present hotbeds of leishmaniasis have been recognized, and to them should be allotted the task of discovering new cases by means of spleen puncture;

(*c*) An entomological and parasitological research including the study of the children's ectoparasites, those of men in general, dogs, &c., the researches to be connected with one of the present existing centres of epidemiological studies.

These investigations would form the basis of experimental researches and should, in my opinion, be undertaken after a very thorough study of local factors and of the habits of domestic life of the people affected by leishmaniasis.

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[1] This bibliography is collected in the work of P. Luengo, de Buen, and E. Luengo: " Siete casos de kala-azar infantil en las provincias de Cáceres y Toledo " (*Archivos de Cardiologia y Hematologia*, Octubre, 1922), and in my book: " Enfermedades de los paises cálidos y Parasitología general " (edit. Calpe, 1923). The new cases published last year by the members of the Commission for fighting paludism in the central provinces are described in the following publications:—

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[2] Messrs. García del Diestro, Gonzalez Barrio, Romeo Lozano, Bravo Frias, Fernandez Truegas are the Madrid pædiatrists who have occupied themselves chiefly with leishmaniasis. It is to M. Garcia del Diestro we owe the knowledge of the first local case of Madrid: " El primer caso de kala-azar en Madrid," *Revista clinica de Madrid*, Diciembre 30, 1914. The puncture of the little patient's spleen was practised in my service of the Institute of Hygiene Alfonso XIII, by M. Garcia del Diestro and myself.

The children's specialist, Mr. E. Suñer, at present Professor in Madrid, has studied lately a certain number of cases, four of which have been quite recently published by Miss Gonzalez Barrio: " Nuevos casos de kala-azar en Madrid y su provincia," *Archiv de Cardiologia y Hematologia*, Madrid, August, 1925.

Mr. Martinez Vargas (pædiatrist in Barcelona) and Messrs. Gomez Ferrer, Aguilar Jordan, Comin (of Valencia) have greatly contributed to increasing our knowledge concerning the endemic of leishmaniasis in Spain.

[3] G. Pittaluga. " El kala-azar infantile (esplenomegalia parasitaria de los niños) en la costa de Levante de España," *Rev. clinica de Madrid*, Octubre 1, 1912.

[4] G. Pittaluga—*loc. cit.*, Octubre 1, 1912—and J. Torrademè: " El kala-azar infantil en el termino municipal de Perello " (Tortosa). Doctoral Thesis, Madrid, November, 1914.

[5] Manuel Vilá. " Contribución el estudio del kala-azar infantil en el partido judicial de Tortosa." Doctoral Thesis, 1913, printed by Guerol, Tortosa (see p. 62). You find in Tortosa, for example, twenty-seven cases of children's deaths between 8 months and 5 years, declared as " leucemia," " splenitis," " anémia perniciosa," " noma," &c., between 1903 and 1912.

Fidel Fernandez Martinez gives in his doctoral dissertation (" El kala-azar en las costas granadinas," 1913, Granada, imp. Guevara), as well as in later publications, the totals observed in seventeen villages in the provinces of Granada and Almeria. Some of these figures are interesting as pointing to the endemic character of kala-azar (Motril, &c.).

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[8] The two last-named cases, as yet unpublished, were directed for puncture of the spleen to my laboratory by my colleague and friend, Mr. Bravo Frias, Public Assistance doctor of the town of Madrid, and specialist in children's diseases. One of the cases has been observed by Professor Nocht and Professor Brumpt (August 17, 1925).

[9] Of these fifty-five cases more than thirty have been presented on August, 18, 1925, at the dispensary of Talavera de la Reina (Toledo), by Mr. David Ortega, to the Commission on Paludism, during its stay in Spain. Among these sick persons was a woman of 23 years.

[10] ALVAREZ, D. "Un caso de kala-azar em Lisbôa" (*Medicina Contemp.*, Lisbôa, 1910, pag. 90).

[11] MANUEL CAEIRO CARRASCO. "Revista sintética sobre as leischmanioses viscerais" (Inst. de Anat. pat. de Lisbôa, 1922; *Medicina Contemp.*).

[12] See the works of Padesca (*Arch. de Hig. e Patol. exot.*, Lisbôa, 1913), and those of F. E. Franco ("Two cases of cutaneous leishmaniosis," *A Medicina Contemp.*, Lisbôa, 1915, pag. 203; and "Contribuzione alla conoscenza dell' Anatomia patologica della leishmaniosi cutaneo-mucosa od americana," *Arch. por le scienze mediche*, Torino, 1922).

[13] The diagnosed cases increase daily. It is, therefore, difficult to fix their exact number at a given date. The topographical map accompanying this memoir will give a sufficiently clear idea as to the distribution of the cases and their number in Spain. On that map, which was drawn at the last moment, figure fifteen cases more than in the statistics examined in the text. They concern cases communicated quite recently.

[14] The specific characters of kala-azar splenomegaly have been accurately described in various publications of our school and demonstrated to the members of the Commission for fighting paludism in Talavera (August 18, 1925). We reproduce here a few figures taken from Luengo and de Buen's work (*Arch. de Card. y Hemat.*, Octubre, 1922).

[15] If one takes into account two cases of adult visceral leishmaniasis observed in Tunisia by Lemierre, Leon Kindberg, and Etienne Bernard, and by Burnet and Masselot, it is possible to estimate at sixty-nine the number of cases of tunisian kala-azar, described since 1904 (first case: Laveran and Cathoire) until the month of June, 1925.

The following is the distribution per age of the sixty-nine cases observed:—

Less than 1 year	10
From 1 to 2 years	24
,, 2 to 3 ,, ...	13
,, 3 to 4 ,, ...	5
,, 4 to 5 ,, ...	5
,, 5 to 6 ,, ...	6
,, 6 to 7 ,, ...	2
,, 9 to 10 ,, ...	1
At 26 years	1
At 39 years	1

See *Soc. méd. des Hôp. de Paris*, avril 3, 1925; *Bull. Soc. Path. exotique*, mai 13, 1923.

A comparison may be drawn with the Italian cases (Jemma, Longo, Di Cristina, Caronia, &c.), Greek and Algerian cases.

[16] Dr. Camacho Alejandre has established with precision the small "domestic" centres of visceral leishmaniasis which originated in Almuñecar (prov. of Granada), in farms and country houses, even very distant from each other. Vilá and Torrademè have observed, too, that certain localities (Perelló, Fullola) always furnished more numerous cases than others. Jemma and his collaborators have made the same observation in Palermo, and later in Naples. See, for example, A. Javarona, "Cronaca della leishmaniose infantile a Napoli e dintorni" (*La Pediatria*, No. 15, vol. xxviii, 1920). A few cases of infection of two brothers are reported by the staff of our anti-paludian service and one case of infection of the mother (23 years) and her child has been observed by Ortega in Talavera de la Reina.

[17] The sickness befell a child belonging to a well-to-do Madrid family, who had stayed during the summer at a farm in the province of Almeria.

[18] Of twenty dogs examined by Torrademè (spleen, liver) Vilá diagnosed only in two cases the presence of leishmania. Of forty-five examined by Vilá himself two cases only proved positive.

[19] Leishmaniosis canina (*La Medicina Valenciana*), año xvi, Junio, 1916, No. 185.

[20] De Buen has studied the characters of the parasite-bearing cells of the spleen (*Arch. de Card. y Hemat.*, January, 1923).

[21] See in particular Franco's works (Lisbon), 1922.

[22] In the case of a patient, aged 46 years, published by Vilá (*Rev. Clinica de Madrid*, December 30, 1914), we have ourselves discovered forms of leishmania in the peripheral blood. In a 13-year-old patient de Buen has observed the same fact.

[23] The Commission for studying kala-azar in India, constituted on May 18, 1921, consisted of Colonel S. R. Christophers (president), Captain Barraud (replacing Major F. W. Cragg, deceased), and a protozoologist (Major H. E. Shortt). This commission has just published its preliminary report. From the latter certain facts, which have to be considered final, may be deduced. They can be summed up as follows:—

(*a*) The researches undertaken in Golaghat and Madras with the object of establishing or rejecting the possibility of a direct or indirect transmission of the leishmania by the intestinal canal, or by contact in general, have given absolutely negative results. The hypothetical part played by the intestinal helminths, chiefly *Ankylostoma duodenale*, in such a transmission, has equally been rejected.

(*b*) The parallel researches pursued by Major R. Knowles and Dr. Napier, at the School of Medicine in Calcutta, proved (October, 1924) that the phlebotomes (in particular *Phlebotomus argentipes*, a species peculiar to British India) can infect themselves through biting people suffering from kala-azar, and exhibit in the mesogast protozoan parasites very similar to the flagellated type of leptomonas, which represent, as we know, the leishmania's stage of development in mediums of artificial culture.

These conclusions have been confirmed in Assam by the members of the Commission (January, 1925). Twenty-five per cent. on an average of the phlebotomes fed on kala-azar patients' blood will become, after a few days, bearers of flagellated protozoa of this type.

(*c*) These researches give, of course, nothing definitive as to the actual transmission of leishmania. A very difficult task

still remains to be accomplished with a view to avoiding spontaneous infections of the protozoa-bearing insects; to explaining the passage of the virus into the organs of the insect and establishing the duration of the evolutive circle, &c.; to proving, at last, in the experimental way, that the phlebotomes bearing those forms of flagellated protozoa, may, indeed, infect healthy persons and transmit to them leishmania. This discovery is very interesting, especially if compared with the demonstration given by Sergent of the possibility of inoculating through the phlebotomes the "bouton d'Alep," viz., a cutaneous form of leishmaniasis.

[24] The study of the leucocytarian formula is commonly practised in all the cases of leishmaniasis observed by our school, before puncture of the spleen and as a complement of leucopenia, and for which we are always searching and which is indeed more frequent than one thinks, and almost constant. Now, there is always an eosinophilia, or a very reduced figure of eosinophiles.

[25] The study of ankylostomiasis has been pursued this year in Spain by a commission of the Rockefeller Foundation, conducted by Dr. C. Bailey, aided by Drs. Ortiz de Landazuri and Pacheco, and our resident physician, Dr. Oquineña. I recall here the question of the possible coincidence of ankylostomiasis and kala-azar, because the Commission presided over by Christophers in India had made it one of the subjects of its researches.

[26] Professor R. JEMMA. "Brevi considerazioni su 110 casi di leishmaniosi infantile osservati nella clinica pediatria di Palermo" (*La Pediatria*, No. 2, 1914).

[27] CH. NICOLLI. "Le kala-azar infantile" (*Ann. Inst. Pasteur*, vol. xxiii, 1919). See page 470.

[28] G. PITTALUGA and S. de BUEN. "Nota sobre los dipteros del gen. Phl. en España" (*Bol. del. Ins. Nac. de Higiene de Alfonso XIII*, vi, 1917). "Especies españolas del gen. Phl." (*Bol. R. S. Espanola de Historia Natural*, xviii, 1918, page 377).

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An Epidemiological Consideration of the Transmission of Kala-azar in India (L. E. Napier, *Indian Medical Research Memoirs*, February, 1926).—There is considerable evidence in favour of the hypothesis that man forms an essential link in the endless chain of kala-azar transmission, but the hypothesis is not proven. There is very strong evidence that the disease cannot be spread without the aid of an intermediate host, but again the case is not proven. The transmitter is probably a blood-feeding arthropod; on epidemiological grounds only it seems most probable that it is a member of either the genus *Phlebotomus* or the genus *Culicoides*. In the case of most arthropods which have been suggested as possible transmitters of the disease there are numerous epidemiological observations which negative the suggestions, but in the case of *Phlebotomus argentipes* every single epidemiological observation appears to be in keeping with the theory that this insect is the transmitter of the causative organism of kala-azar. Although it is possible that at some future date our knowledge of the geographical distribution and habits of other species of arthropod may point to still other possible hosts, at the present time on epidemiological grounds *Phlebotomus argentipes* can claim the first place in the list of possible transmitters of kala-azar. The obtaining of a more exact knowledge of the distribution of *Phlebotomus argentipes* in the Indian Empire appears to be a most important step towards proving that this insect is the transmitter of kala-azar in India.

Notices.

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YAWS IN THE PHILIPPINES.

IN a recent number of the *Philippine Journal of Science*[1] seven of the eight papers which appear are devoted to the subject of yaws. In the first Lopez-Rizal, Gutierrez and Fernandez describe a field experiment in the control of yaws, giving the results

[1] *The Philippine Journal of Science*, vol. xxx, No. 4, August, 1926, containing: "A Field Experiment in the Control of Yaws," L. Lopez-Rizal, P. Gutierrez and L. Fernandez. "A Serological Estimate of the Efficacy of Neosalvarsan in the Treatment of Yaws in a Field Dispensary," R. J. Navarro. "Investigation of Immunity in Yaws," G. R. Lacy and A. W. Sellards. "Superinfection in Yaws," A. W. Sellards, G. R. Lacy and O. Schöbl. "Some Protean Manifestations of the Skin Lesions of Yaws," O. Schöbl, A. W. Sellards and G. R. Lacy. "The Globulin Precipitation Reaction in Yaws. Its Independence of the Wassermann Reactionand its Behaviour during the Course and Treatment of the Disease," O. Schöbl and J. Ramisez. "A Clinical Modification of Yaws observed in Patients Living in Mountainous Districts," L. Lopez-Rizal and A. W. Sellards.

obtained by the Philippine Health Society since the opening in 1921 of a dispensary in Parañaque, Rizal Province, for the purpose of investigating the feasibility of extending yaws campaigns throughout the Philippines. Sixteen years have elapsed since the specific action of salvarsan in yaws was first demonstrated in Ceylon by Castellani, and in the Philippines by Strong, and this has been abundantly confirmed since then. Although so potent and effective in the treatment of yaws, salvarsan is wholly ununsuited for routine work under field conditions. These objections however, do not apply to neosalvarsan and all known cases in Parañaque, as revealed by a house-to-house canvas, having been treated with it. The dosage was approximately 0·01 grm. per kg. of body weight, although a slightly larger dose was given to children and infants, who seemed to tolerate the drug better. The patients received from one to seven injections. During approximately four years 1,151 cases were treated, with the gratifying result that yaws has been brought under complete control in a district which has been heavily infected from time immemorial.

The intermittent operation of yaws dispensaries was found to be an unsatisfactory procedure for the control of the disease in very heavily infected communities. Intensive treatment and persistent vigilance, so as to ensure complete recovery of existing cases, is the most important factor in the control of the disease.

Navarro employed serological measures to estimate the efficacy of neosalvarsan in the treatment of yaws. Accepting as an established fact that the Wassermann reaction is constantly and strongly positive in the active secondary stage of yaws Navarro assumed that the Wassermann reaction was positive in the cases before the treatment with neosalvarsan. Over 80 per cent. were negative from three months to three years after the cessation of treatment and more than half of these had received only one injection. The very brilliancy of the results of a single injection of neosalvarsan carries with it some measure of disadvantage in that many patients do not trouble to return for further treatment.

Investigating immunity in yaws Lacy and Sellards found that reinfection with yaws after treatment by neosalvarsan usually resulted after six months either with characteristic or atypical manifestations, whilst after two years three out of four cases showed well-marked resistance to reinfection. It would thus appear that active immunity develops late in the secondary stage of yaws.

Many points of similarity between yaws and syphilis have been noted, and it is well established that a typical chancre cannot be produced in a patient already infected with syphilis. An investigation was undertaken by Sellards, Lacy and Schöbl to determine whether superinfection is possible in yaws, with the result that in all of five reinoculated patients typical granulomata appeared at the site of inoculation, showing that, in contrast to syphilis, superinfection in yaws is possible, even after the typical primary granulomata have developed. Discussing some protean manifestations of the skin lesions of yaws Schöbl, Sellards and Lacy have shown that the skin manifestations of *Treponema pertenue* are almost as varied as those produced by *T. pallidum*.

Schöbl and Ramirez found the practical value of the globulin precipitation reaction as a confirmatory test of clinical diagnosis of yaws in the pre-Wassermann stage, and as a useful reaction for the guidance of the extent of specific treatment is strongly indicated.

Describing a clinical modification of yaws observed in patients living in mountainous districts Lopez-Rizal and Sellards point out that yaws is widespread in the mountains of northern Luzon, at elevations varying from approximately 600 to 2,100 metres. The disease is endemic in the mountains and propagates itself independently of any communication with inhabitants from the yaws centres of the lowlands.

Clinically, the yaws occurring in the mountainous districts shows a striking peculiarity in that the cutaneous lesions in the majority of the patients (90 per cent.) are limited to the muco-cutaneous junctures of the mouth, nose, anus and genitalia. It would appear difficult to explain this peculiarity in the distribution of the cutaneous lesions, since generalized enlargement of the lymphatic glands indicate the systemic distribution of the causal treponemata.

F. E. T.

Annotations.

Studies on Regeneration of Bacteriophage. The Influence of Oxygen Upon the Behavior of Bacillus Coli towards Lytic Principle (G. Schwartzmann, *Journal of Experimental Medicine*, June 1, 1926).—The investigations of the influence of oxygen on the bacteriophage show that this factor plays an important rôle which is due exclusively to its ability to induce certain changes in the behaviour of bacterial cells towards lytic principle. At certain H-ion concentration, both aerobic and anaerobic cultures can be made resistant in the absence of lytic principle. The resistance thus acquired is of a stable nature under suitable conditions. If the lytic principle is added to aerobic or anaerobic types of resistant strains the cultures are able to regenerate it to a certain extent. However, they do not undergo any visible lysis themselves even under the action of lytic principles which were passed through several generations of these types. The principles regenerated by both types of resistant cultures are identical in action with each other as well as with the stock lytic principle. These experiments suggest a new method of investigation into the hitherto unexplained nature of resistance of bacteria towards bacteriophage.

The Epidemiology of Pneumonia (*a Study of Pneumococcus Carriers among four groups of persons over a period of months*) (J. P. Powell, R. M. Attwater, and L. D. Felton, *American Journal of Hygiene*,

July, 1926). — The purpose of this investigation was to study the distribution of pneumococci among normal persons, the persistence of the organism in the respiratory tract, the virulence of the organism, and the existing relationships between the carrier state and season, age, sex and occupation. This study covers 418 observations on ninety-three persons in four groups—high school boys, medical students, student nurses and laboratory workers all living in the same city and during the same period. There is good evidence that very few persons can long escape contact with some form of the pneumococcus under the conditions of ordinary life. Moreover, contact with one of the fixed types of pneumococcus forms associated with 80 per cent. of all cases of pneumonia is demonstrated for half the group during a period of seven months. Presumably, then, practically everyone at sometime during the course of a year is a carrier of a fixed type of pneumococcus. Waves of unusual prevalence of the fixed types of pneumococci are described. These were not accompanied by corresponding cases of pneumonia in the same group. The figures for that year, in Boston, indicate that there was about one case of pneumonia for every 175 residents during the period of investigation. This group consisted of ninety-three persons, so that the fact that only one person developed the disease was within expected limits. The prevalence of carriers of the different types of pneumococci, chartered by months, suggests that we are dealing with organisms that go through seasonal variations in prevalence, variations which are probably different for the several types of the pneumococcus. The study of virulence by months also suggests that we are dealing with a biologic function of the parasite, analogous to well known seasonal activities in the plant kingdom. Study of the persistence of pneumococci in the respiratory tract of carriers shows that at least the fixed type organisms tend to disappear from the mouth and throat in less than thirty days. This was true in thirty-seven instances out of forty-five carriers who were found with these organisms. There was one instance in which a Type III pneumococcus was found in a person over a period of at least 120 days and there is reason from virulence studies to believe that this was persistence rather than reinfection. Three other cases showed persistence of from sixty to ninety days, but these were exceptions. Type IV pneumococcus shows a persistence which is regarded as apparent rather than real, because of the variability in virulence of successively recovered strains and also because of the multiple opportunities for reinfection with indistinguishable strains of this type. There appears to be no significant difference between the sexes in their tendency to become carriers of the pneumococcus. The four groups of persons show evidence that their mutual associations favour local contact and their pneumococci tend towards a uniform distribution of types within each group at one time. When normal persons carry fixed types of pneumococci, they are rarely able to give any clue as to the source of these pathogenic varieties, a fact that has been brought out before. These observations confirm the fact that persons in contact with cases of pneumonia more frequently carry fixed type pneumococci in their throats than controls, but carriers of fixed types are rather frequent among the population at large. Persons may also get their pneumococci from contact with carriers. Therefore the isolation of cases of pneumonia could not be expected to be more than partially effective in controlling the disease. Studies on the virulence of 216 strains, isolated during this investigation and tested on white mice, indicate that Types I and III tend toward a higher level of virulence than Types II or IV. In comparison with another study made in Boston and during the same year, there is observed an essential consistency of the virulence in all types recorded excepting Type II, in which an unusual number of avirulent strains were encountered. The findings in this study, when compared with similar material from other sources, show an essential consistency. In this composite fashion the data on carriers of pneumococci among 895 normal persons are given by types. Another comparison of data from 868 persons in Boston shows the definite excess of carriers among normal persons exposed to cases of pneumonia. In general these data serve to confirm the view that the disease pneumonia appears when there is a coincidence between infection with a pathogenic form of the pneumococcus and a lack of resistance in the same individual.

A Case of Giardia Intestinalis treated with Stovarsol (J. L. Pawan, *Annals of Tropical Medicine and Parasitology*, June 24, 1926).—Dobell states that emetine and methylene blue have no effect upon *Giardia intestinalis* or any of the other "common intestinal flagellates." Oral administration of salvarsan is said to have cured cases in human beings, by Bavant, Carr, and Chandler, and in mice and rats, by Rogers, Kofoid, Yakimoff and others, but Dobell finds the evidence for cure in these cases inconclusive. "It appears probable," he says, "from the evidence at present available, that no specific treatment for infection with any species of intestinal flagellates has yet been discovered. When negative examinations are made during or after a course of 'specific' treatment, they cannot be regarded as evidence of 'cure' unless they extend over a period much longer than any 'negative period' which may be observed in any untreated cases." In the case recorded examination of the fæces on January 26, 1926, i.e., twenty-eight days after the last 'negative' examination, still showed no *Giardia*."

Evaluation of the Methods of Stoll and Lane in Light Hookworm Infections and Accuracy in Diagnosis of the Willis Flotation Method (W. C. Hausheer, C. A. Herrick and A. S. Pearse, *American Journal of Hygiene*, July Supplement, 1926).—In a series of seventy carefully studied stools the regular Stoll technique (large drop) will detect cases having as low

as fifty eggs per grm. by Lane count, if not less than two slides are examined. Lane's method, pushed to finality, demonstrated 68·3 per cent. of the ova indicated present by the regular drop dilution egg-count, and diagnostically showed every Stoll positive. The small drop Stoll technique demonstrated 94·5 per cent. of the ova shown present by the regular dilution counts. The small drops failed diagnostically (two slides only being counted from each tube) in 75 to 80 per cent. of cases having less than 200 ova per grm., but showed high diagnostic efficacy in the higher counts. An analysis is presented of the Willis flotation method, and its efficacy when properly handled is emphasized. It would appear to be as accurate as Lane's direct centrifugal flotation when certain details in its use are observed.

The Relation between the Age and the Virulence of Cultures of Bacillus Aertrycke (Mutton) (G. S. Wilson, *Journal of Hygiene*, July, 1926).—Four batches of sixty mice were injected with comparable doses of *B. aertrycke* (Mutton) taken from broth or agar cultures in different phases of reproductive activity. The mortality and the average survival time of the mice after injection varied so little amongst the different groups as to justify the conclusion that no difference in the virulence of this organism is detectable during the first week of growth.

The Further Development of Onchocerca Volvulus Leuckart in Simulium Damnosum, Theob. (D. B. Blacklock, *Annals of Tropical Medicine and Parasitology*, June 24, 1926).—Larvæ of *O. volvulus* taken from the skin by *S. damnosum* in biting, undergo progressive development in the fly and finally reach the proboscis; the time taken to complete the development depends largely upon temperature.

The shortest period which elapsed after feeding before the proboscis became infected was seven days. The mature larvæ are found in the labium of the fly and escape through the membranous portion of it. In so far as experiments with wild flies can be accepted as evidence in the absence of transmission to man or animal, *S. damnosum* is a vector of *O. volvulus*.

A Study of the Incidence of Kala-azar in certain parts of North Behar. (D. F. Michael, *Indian Medical Research Memoirs*, July, 1926).—Kala-azar is endemic in the districts of Darbhanga and Muzaffarpur. Certain villages are foci of infection, notably the villages of Rampur Bakhri, in the Muzaffarpur District and possibly also Mahespur in the same district and Mahanada and Malinagar on the Darbhanga side. The villages forming the eastern, western and southern boundaries of Bakhri are slightly infected as judged by the number of cases reported, while Mahanada on the north side appears to be fairly heavily infected—exemplifying "site infection." Lack of conservancy, defects in domestic and personal hygiene and the presence of dirt in and around houses are apparently definitely connected with the prevalence of the disease. The institution of hygienic measures in an infected area combined with the treatment of cases of the disease seems to lessen the incidence in a striking manner. The disease is most prevalent when humidity is relatively high and markedly less during dry weather. Children and young adults to a slightly less extent show the greatest susceptibility. In this connection it is worth while to note the comparative immunity to the disease which people of the sweeper class enjoy. Not a single case has, to the author's knowledge, occurred amongst either the hospital sweepers or the Pusa Estate Conservancy Establishment or their families during the past four and a half years, while children of other servants in attendance on the sick in hospital have contracted the disease.

Observations upon Hookworm Disease in Mexico (H. P. Carr, *American Journal of Hygiene*, July Supplement, 1926).—It has been shown that hookworm disease in Mexico is confined to certain areas, and the limits of these areas have been determined. The incidence of hookworm disease in this area and the average individual infestation has also been determined. There was a high degree of negative correlation between the egg-count and the hæmoglobin of groups of individuals belonging to the labouring class in Mexico. There was no difference in the average hæmoglobin of groups of individuals, whether they showed no hookworm infestation by the egg-count method or whether they showed a very light infestation by the same method. Evidence has been presented which indicates that the predominant species of hookworm in Mexico is *Necator americanus*.

Hookworm Reinfestation for Three Years after Treatment in a Sanitated Area in Porto Rico and its Bearing on Permanent Hookworm Control in the Group Studied (R. B. Hill, *American Journal of Hygiene*, July Supplement, 1926).—A quantitative study, by the use of the dilution egg-count method, was made on a group of approximately 300 people in a sanitated area in Porto Rico before and just after treatment, one year after treatment, and three years after treatment. Treatment reduced the incidence from 90 per cent. to 19 per cent. of the people. The rate rose rapidly the first year, less rapidly thereafter to 58 per cent. after three years. The intensity of infestation was reduced 98 per cent. by treatment and this rose to 20 per cent. of the original infestation in three years. Farmers showed the greatest absolute increase, children under ten years of age the greatest relative increase. In neither group was the infestation heavy after a period of three years. It is concluded that sanitation and intensive treatments have given results of permanent value in the control of hookworm disease in Porto Rico.

The Action of Hepatic Extract in Hypertension (R. H. Major, *Journal of the American Medical Association*, July 31, 1926).—As previously stated, it is still felt that definite conclusions regarding the action of hepatic extract in hypertension can be drawn only after a large number of patients have been treated over a long period of time. The evidence, at the present time, that the liver extract is effective in certain cases of arterial hypertension is very suggestive but is not conclusive.

The Place of the Smear in Hookworm Diagnosis (W. C. Hausheer and C. A. Herrick, *American Journal of Hygiene*, July Supplement, 1926).—The smear method is diagnostically accurate if the intensity of infestation is such that 500 or more ova are present per grm. of fæces. The smear method, if only two slides are examined for a negative, will fail in a certain percentage of cases yielding between 300-500 per grm. of stool. If less than 300 ova are present per grm. of stool the smear is highly inaccurate. When the above factors are taken into consideration the smear method may be used with confidence; it is simple, rapid, and still holds a valuable place in the fæcal examination for hookworms.

A Proposed Method of Laboratory Evaluation and Classification (J. B. Peterson, *Journal of the American Medical Association*, July 24, 1926).—A laboratory classification of mercury compounds has been made by measuring their inhibiting effect on the yeast-sugar fermentation. All the values were compared with their inhibiting value of mercuric chloride. The inhibiting effect of the yeast-sugar fermentation in most cases is due to the mercuric ion concentration, although in some cases other components of the solution are concerned. Molecules identical with flumerin, mercurochrome and metaphin, except for their respective mercury carrying groups, show considerable inhibitory power. The inhibiting value of crystal violet, methyl violet and gentian violet has been measured and compared with the inhibiting value of mercuric chloride. It is recognized that the work of classification of substances, particularly antiseptics, according to their behaviour, chemical, bacteriological and clinical, is far from complete.

Reviews.

THE BIOLOGY OF THE PROTOZOA. By Gary N. Calkins, Ph.D., Professor of Protozoology, Columbia University. Illustrated with 238 engravings. London: Baillière, Tindall and Cox. 1926.

It was a heterogeneous mass of microscopic living organisms which was revealed to the scientific world by van Leewenhoek in the seventeenth century from which the protozoa, microscopic single-celled animal forms, have been gradually differentiated, although even at the present day we are unable clearly to differentiate them from multicellular vegetable organisms. It was to avoid this difficulty that Haeckel introduced the term protista to embrace all unicellular organisms, but, as Calkins remarks, this is merely another name for the aggregate and an artifice for concealing the real difficulties which we would like to overcome.

In the work before us the author tells us that he has brought together the conclusions founded on thirty years of research on the protozoa and on an equal number of years of teaching protozoology, and ventures to hope that the presentation may be a step towards the unification of the various phases of protozoa-study and a suggestion of a common point of view in protozoology.

He deals first with the distribution and general organization of the protozoa, with their structural differentiations and their nuclei and kinetic elements, and then with their general physiology, discussing their life organization and vitality and the functional activities of the individual. Then follows a chapter on reproduction, including both unequal division (budding or germination), whether exogenous or endogenous, and multiple division or spore formation.

One chapter each is devoted to a description of the special morphology and taxonomy of each of the four great groups of protozoa, to wit, mastigophora, sarcodina, infusoria, and sporozoa, after which follow chapters on vitality, on the phenomena accompanying fertilization and the effects of reorganization and the origin of variations in the protozoa.

Throughout the volume one underlying biological principle has been constantly kept in mind, namely, the irritability of protoplasm, combined with protoplasmic organization.

The various types of organizations which form the basis of classification are systematically described, keys being added to assist in placing the commoner genera.

The fundamental vital functions are treated as manifestations of vitality. Life and vitality are treated as independent concepts—life as organization, and vitality as the activity of the organization. The various phases of vitality—youth, maturity and old age—are consequences of changed or changing organization through continued metabolism, whilst death is the disintegration of the organization.

Dr. Calkins is to be congratulated on having produced a great zoological volume, which must prove of immense value to the serious student of protozoology in its more zoological aspect, who will derive great benefit, not only from the author's descriptions but also from the numerous keys and well-executed diagrams, from the extensive references supplied, as well as from the exhaustive indexes, both of authors and subjects, which complete this masterly volume.

F. E. T.

Original Communication.

VARIATIONS IN THE VIRULENCE AND IN THE MORPHOLOGY OF CERTAIN LABORATORY STRAINS OF *TRYPANOSOMA GAMBIENSE* AND *TRYPANOSOMA RHODESIENSE* ISOLATED FROM HUMAN CASES.

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Introduction.

Since the discovery of trypanosomes as the cause of disease in man numerous observations have been made on human strains when inoculated into laboratory animals, as regards the virulence they display, and also the morphological changes which occur in the new host. *Trypanosoma gambiense* and *Trypanosoma rhodesiense* can probably be inoculated successfully into most mammals, although those used most commonly for experimental purposes are rats, mice, guinea-pigs, rabbits and monkeys, but they certainly show decided differences in their virulence. Thus *T. gambiense* is frequently by no means easy to isolate in rats, and, even when infection has been established, the first few passages commonly produce a disease in the animals of an extremely slow, chronic nature. On the other hand, it is usually a comparatively simple matter to produce an initial infection in rats with *T. rhodesiense*, which, after a few subinoculations, becomes an acutely fatal disease. It is also well known that in such experimental hosts as rats, &c., the morphological characters of the two species under discussion alter considerably. These differences in virulence and animal reactions in general have been so exhaustively studied and noted in the literature by Bruce and Coll (1903), Thomas and Linton (1904), Laveran (1908), Brumpt and Wurz (1904), Beck (1910), Bentmann and Günther (1907), Yorke (1910), and others that it is not intended to deal in this paper with the subject in its entirety, but rather to draw attention to one or two important details which have not been thoroughly explained.

Duke (1921 and 1922) brought forward some interesting observations regarding the unity or plurality of species of the African polymorphic trypanosomes, and, while avoiding anything in the nature of a dogmatic attitude, he advanced the hypothesis, strongly supported by his personal experience and experimental work, that there was only one true species. He points out that good species are based on their morphological characters, not merely on certain peculiarities due to physiological or environmental variations, and that, in the event of the differences, say between *T. gambiense*, *T. rhodesiense* and *Trypanosoma brucei*, falling within the limits of such variation, they could be regarded, from the systematic point of view, as "races," "strains," or "varieties" of a single species. In other words, if *T. brucei* is the species, then *T. rhodesiense*, *T. gambiense* and *Trypanosoma nigeriense* are to be regarded as particular strains of that species, so-called "physiological variants." The same author (Duke 1923) suggests the possibility of *Trypanosoma evansi*, *Trypanosoma equinum* and *Trypanosoma equiperdum* having originated at some time from the polymorphic group, that, as a result of prolonged mechanical transmission, the trypanosomes have assumed different morphological features. Possibly the cyclical transmission in the tsetse-fly keeps the trypanosomes true to type, and this must be borne in mind when dealing with laboratory strains which are mechanically transmitted from animal to animal. Duke also advances the view that the polymorphic trypanosomes of Africa owe their present differences largely to the influence of the vertebrate on which, in the course of time, they have become dependent as their main blood-host.

These views, stated so clearly and ably by Duke, have undoubtedly occurred to other workers. In the present instance, when dealing with five distinct strains isolated during recent years from four human cases, four of which were *T. gambiense* and one *T. rhodesiense*, certain interesting facts have been elicited showing that, with the passage of time, strains, mechanically transmitted, may change entirely in their morphological characters, and, further, that under certain conditions, which will be specified later, the typical morphological features of the original strain can be obtained again.

Variations in the Virulence to Laboratory Animals of Strains of Trypanosomes from Human Cases.

It is now a well-established fact that rats are comparatively refractory to the initial inoculation with *T. gambiense* from human cases, while later the virulence may become remarkable. On the other hand, the subsequent history of the strain may show that the virulence increases slowly, and, even after a considerable number of passages, may produce a disease in rats characterized by its chronicity. Both these points are well illustrated in the histories that follow

Strain H (*T. gambiense*) was isolated from a patient, H. (European), aged 26 years, who had become infected at Mabang in the Sierra Leone Protectorate. Following discovery of trypanosomes in his blood on December 27, 1918, he returned to this country, and was admitted to hospital on February 15, 1919, when the organisms, though not numerous, were still present in his blood. On February 20, 1919, two rats each received intraperitoneal injections of 2 c.c. of blood, and in a few days' time, trypanosomes appeared in their peripheral blood.

Thereafter the strain was easy to maintain, and its virulence rapidly increased. One point, however, ought to be noted, the strain was not maintained solely in rats, but guinea-pigs were frequently

interposed in its lineal passage. The strain was kept going in the laboratory for about two years, at the end of which time the virulence had increased to such a degree that rats succumbed in from two and a half to three days, and guinea-pigs in a week or less.

Meantime the patient H, having become discontented in hospital, had departed before his cure was established, but in October, 1920, owing to a recrudescence of symptoms, he returned for further treatment. On this occasion trypanosomes were found to be still present in his blood, and accordingly two rats were inoculated on October 8, 1920. One of these rats died in a few days' time from an intercurrent pneumonic condition; the other never showed trypanosomes, but, on May 6, 1921, six months after the original inoculation, it was killed, and its heart-blood inoculated into two other rats. Trypanosomes appeared in one of these animals in five days' time, and this was the origin of Strain H2.

TABLE SHOWING LINEAL DESCENT OF STRAIN H2.

Number	Source of infection	Date of inoculation	Date of death	Number of days' incubation	Duration of infection in days
1	Patient	8. 10. 20	6. 5. 21	—	210
1a	,,	8. 10. 20	Died from pneumonic infection a few days after inoculation		
2	1	6. 5. 21	18. 10. 21	5	135
2a	1	6. 5. 21	4. 9. 21	Never showed	121
3	2	25. 8. 21	30. 9. 21	21	36
4	3	15. 9. 21	12. 1. 22	32	119
5	4	17. 10. 21	17. 2. 22	Never showed	121
5a	4	17. 10. 21	14. 2. 22	43	118
5b	4	2. 11. 21	18. 1. 22	50	77
5c	4	2. 11. 21	3. 2. 22	50	93
6	5b	22. 12. 21	19. 6. 22	63	179
6a	5b	22. 12. 21	11. 6. 22	46	171
7	6a	8. 2. 22	18. 2. 22	Never showed	10
7a	6	1. 3. 22	4. 4. 22	28	34
7b	6	1. 3. 22	30. 3. 22	20	30
7c (guinea-pig)	6	11. 5. 22	8. 9. 22	12	120
8	7b	24. 3. 22	27. 6. 22	Never showed	95
8a	7a	29. 3. 22	29. 6. 22	27	92
8b	7c (guinea-pig)	14. 7. 22	31. 7. 22	10	17
9	8a	25. 4. 22	27. 6. 22	25	63
9a	8b	24. 7. 22	11. 9. 22	10	49
9b	8b	24. 7. 22	22. 9. 22	9	60
10	9b	15. 9. 22	14. 10. 22	6	29
11	10	22. 9. 22	1. 12. 22	24	40
11a	10	1. 10. 22	16. 10. 22	8	16
12	11a	11. 10. 22	24. 10. 22	6	13
12a	11	21. 10. 22	22. 11. 22	9	32
12b	11	27. 10. 22	28. 11. 22	9	32
13	12a	30. 10. 22	10. 12. 22	10	41
14	13	9. 11. 22	31. 12. 22	14	52
15	14	23. 11. 22	11. 2. 23	11	79
16	15	5. 12. 22	16. 4. 23	4	132
16a	15	15. 12. 22	17. 5. 23	9	153
17	16	5. 1. 23	1. 6. 23	8	147
17a	16a	25. 1. 23	14. 6. 23	9	140
18 (guinea-pig)	17	14. 1. 23	26. 9. 23	11	255
18a ,,	17	14. 1. 23	17. 8. 23	7	215
19	18 (guinea-pig)	12. 3. 23	24. 8. 23	8	165
19a	18 ,,	12. 3. 23	16. 8. 23	10	157
20	19	17. 5. 23	17. 9. 24	8	over 300
21	20	31. 5. 23	24. 10. 24	10	,, 300
22	21	7. 7. 23	10. 12. 24	20	,, 300

By referring to the table showing the lineal descent it will be seen that Strain H2 was maintained through twenty-two direct passages over a period of just over four years. To begin with the virulence was very slight, but, after the sixth subinoculation it showed signs of increasing. It will be noticed also that the period of incubation, by which is meant the number of days which elapsed between the inoculation and the appearance of the organisms for the first time in the peripheral blood of the animal, was decreasing in similar manner. At this point a guinea-pig (Animal No. 7c) was introduced into the line of descent, and this was followed by a rise in the virulence (Animal 8b), reducing the incubation to ten days and killing the rat in seventeen days. Thereafter, with a few slight variations, the incubation period remained wonderfully constant at from eight to ten days, whereas the duration of the infection, i.e., the length of time between the inoculation and the death of the animal, became progressively longer and longer. Trypanosomes were by no means constantly present in demonstrable numbers in the blood of the animals towards the end of the table, but would appear for a few days and then their numbers would gradually tail off again to remain absent sometimes for months. The animals, at this stage of the strain, showed practically no symptoms of disease except towards the

end, when the fatal termination was usually foreshadowed by a marked increase in the number of trypanosomes and their non-disappearance from the peripheral blood.

The patient J. (European), from whom Strain J, *T. gambiense*, was recovered, had received his infection in the Upper Kwilu district of the Belgian Congo. He arrived there in 1919, and was quite well until January, 1920, when he had a few days fever, which, at first, was supposed to be of malarial origin. Blood-films, however, examined a few days later, demonstrated the presence of trypanosomes, and, accordingly, he came home to be admitted to the Hospital for Tropical Diseases on May 31, 1920. Two rats were inoculated the following day intraperitoneally with approximately 2·5 c.c. of the patient's blood.

In parenthesis it may be mentioned that the patient, after a prolonged course of treatment, relapsed, but was eventually discharged apparently cured. It would appear that his infection was of comparatively low virulence, and the disease was of the chronic variety.

TABLE ILLUSTRATING STRAIN J.

No.	Source of infection	Date of inoculation	Date of death	Number of days incubation	Duration of infection in days
1	Patient	1. 6. 20	17. 1. 21	15	221
1a	Patient	1. 6. 20	19. 10. 20	15	140
2	1a	19. 10. 20	26. 10. 21	12	372
2a	1a	19. 10. 20	23. 4. 21	16	186
5	4	11. 10. 21	10. 2. 22	13	122
7	6	22. 2. 22	23. 8. 22	7	182
12	11	17. 10. 22	6. 2. 23	6	112
17	16	9. 2. 23	30. 5. 23	10	110
21	20	24. 7. 23	20. 12. 23	9	149
23	22	8. 8. 23	12. 8. 24	21	283
25	24	30. 7. 24	7. 1. 25	41	161
27	26	5. 4. 25	6. 9. 25	16	154
27a	26	7. 9. 25	27. 2. 26	8	173

The subsequent history of the strain is of interest chiefly on account of the fact that, after the expiration of just over five years and after twenty-seven direct passages, when it was discontinued, the virulence had not altered materially. It will be seen from the accompanying table, showing the particulars of the first and last animals and of a few intervening animals chosen at random, that there was little difference in the period of incubation or in the duration of the disease. A further characteristic of this strain was that about fifteen days, as a rule, after the inoculation trypanosomes appeared in the peripheral blood of the animals, and, although they were in fairly considerable numbers, they disappeared again in from one and a half to three days, and did not reappear until the end of the infection. This is well exemplified in the case of the first two rats (Nos. 1 and 1a), which were inoculated from the patient on June 1, 1920. On June 16, fifteen days later, they both showed trypanosomes. Rat No. 1a, in which the organisms had never returned, was killed on October 19, and its heart-blood was inoculated into another two rats (Nos. 2 and 2a), both of which showed trypanosomes in twelve and sixteen days respectively. Rat No. 1 was allowed to live, and eventually trypanosomes were discovered late in November, five months after the original discovery in the peripheral blood.

The history of the Strain MA, *T. gambiense*, differs in certain particulars from all the foregoing, Strains H, H2 and J. The patient (European), aged 49 at the time of his admission to hospital, had been for some years in a tsetse-free area of Northern Nigeria. In March, 1921, he removed to Southern Nigeria, to an area where tsetses were present, and, although no history of having been bitten was obtainable, he developed fever in July, 1921. It was at first thought that he was suffering from rheumatic fever, but on his admission to the Hospital for Tropical Diseases, November 5, 1921, trypanosomes were found to be present in his blood-stream. He was finally discharged from hospital on March 3, 1923, having been treated first with " Bayer 205 " and then with atoxyl and antimony.

Two rats were inoculated from the patient on November 10, 1921. One of them showed trypanosomes in fourteen and the other in twenty-five days. Since then the strain has been comparatively easy to maintain. The incubation period in rats varied from four to twenty-three days, and in guinea-pigs up to as much as ninety-two days. The majority of the rats showed trypanosomes between the twelfth and sixteenth days.

The Strain M, *T. rhodesiense*, was isolated in the following manner. The patient M was resident in Northern Rhodesia, in an area where tsetse were numerous. He became ill on December 10, 1921, and, on admission to hospital locally, it was found that trypanosomes were present in his blood. He was treated with "Bayer 205," two intravenous injections and three doses by the mouth, about January 14, 1922. Later he made his way south to the Cape and sailed for England, reaching this country on April 6, 1922. On June 8, 1922, he was admitted to the Hospital for Tropical Diseases, and, as he was found still to be harbouring trypanosomes, he received a course of " Bayer 205 " during June, July, August, up to September 18, on which date he was discharged from hospital, no trypanosomes having been found in his blood since June 13. On November 3 he was readmitted, and, despite the fact that " Bayer 205 " was pushed to the limit, he died on January 7, 1923.

During December, 1922, and January, 1923, a series of experiments were carried out with urine from the patient, to determine the effect of the injection of urine from a case undergoing treatment with " Bayer 205 " on rats inoculated with a strain (not the patient's own strain) of *T. rhodesiense* (Thomson and Robertson 1923).

On January 4 two rats were inoculated with blood from this patient, and on January 6 a rat was inoculated with some of his cerebrospinal fluid. One of the rats inoculated with blood died as a result of the inoculation, but the other showed trypanosomes in five days and lived for seventy-five days from the date of inoculation. The rat

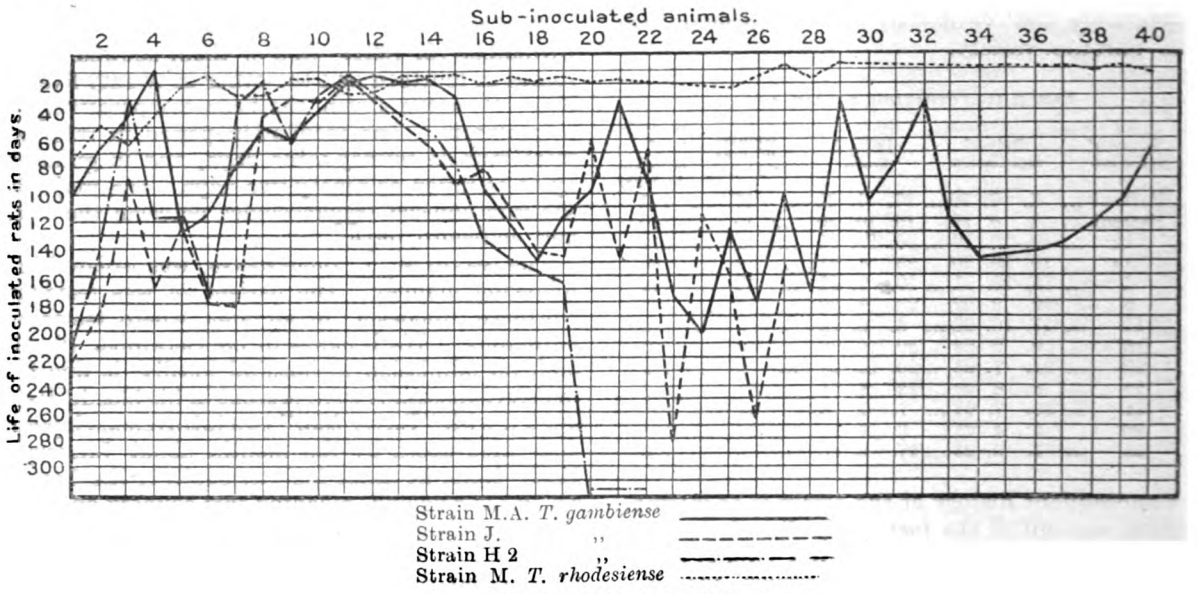
which had the cerebrospinal fluid lived for seventy-four days, trypanosomes having appeared in six days.

A comparison of the relative virulence of the foregoing five human strains, Strains H, H2, J, and MA, *T. gambiense*, and Strain M, *T. rhodesiense*, elicits certain interesting features. It is unfortunate, however, that in the case of Strain H, *T. gambiense*, a complete record of the strain is not now available; the important point with regard to it is that in two years its virulence had increased to a remarkable extent, and at the same time had also become stabilized. That is to say, it killed rats regularly in three days.

In the accompanying graph an attempt has been made to represent the virulence of the four strains. For this purpose the length of life of the animals after inoculation has been taken as giving an approximate indication of the virulence of the strain. In the graph the ordinates represent the subinoculated animals, and the abscissæ the duration of their life in days after the date of inoculation. Thus the shorter the life of the animals the higher the peak of the virulence. It will be seen that the curves of the three *T. gambiense* strains follow an almost identical course. There is, to begin with, a sharp rise reaching the peak about the third or fourth subinoculation, but falling just as sharply at the fifth, six and seventh. The virulence of all three rises again to form a sort of plateau, roughly between the eighth and twelfth passages. The decline from this plateau is gradual up to the nineteenth animal. After that point the Strain H2 became very avirulent, and, indeed, was only carried on through three more sets of rats, Nos. 20, 21 and 22, when it was discontinued. The other two strains, i.e., Strains J and MA, *T. gambiense*, on the other hand, followed a swinging course, the virulence practically alternating with each passage between what may be termed the two extremes. Strain J was tending also to become rather avirulent, and it was dropped at the twenty-seventh passage. More recently the Strain MA has lost, to a large extent, its swinging character, and has killed the animals in between eighty and one hundred and twenty days.

In marked contradistinction to these *T. gambiense* strains the *T. rhodesiense* very soon attained a fixed virulence, which has been steadily maintained ever since.

It seems a curious coincidence the way in which all three strains follow such parallel courses. There may be no special significance attached to it, and no explanation is attempted. That it is due, perhaps, to outside influences seems unlikely, since the dates on which the various subinoculations were performed did not correspond in any way and the animals were obtained from time to time from different sources.



For explanation see text.

Alterations in the Morphological Characters of the Strains after a Series of Mechanical Transmissions.

All the strains of *T. gambiense* and *T. rhodesiense*, including other strains not specified in the foregoing sections, which have been maintained in the department during recent years, have shown certain alterations in their morphological characters, which have resulted in the production of forms somewhat similar to those found in infections with *T. evansi* and *T. equiperdum*. In other words, instead of showing a well-marked polymorphism they have become after a varying number of passages, to all intents and purposes monomorphic, with the prevailing form, the long, thin trypanosome with a conspicuous free flagellum. Strain H, at its most virulent stage, was a good example of this state of

affairs. Of the other three strains, Strains H2, J and MA, in which the virulence was comparatively low, the polymorphic character was lost much more gradually; indeed, in the Strain MA it can still be recovered easily by side-tracking the strain from rats through a guinea-pig. It is interesting to note that in the Strain H2 forms appeared early in the series of passages indistinguishable from the short forms (about 8 microns in length) which have been described in connection with the so-called *T. nigeriense* variety of *T. gambiense*.

The Strain M behaved in the fashion usually found with strains of *T. rhodesiense*. That is to say, it showed during the first few passages the well-known polymorphic characters with occasionally posterior displacement of the trophonucleus in the short, stumpy forms. As the strain grew older these posterior-nuclear forms were seen more and more rarely, until they finally disappeared at the eighteenth passage from the rats, and, in the case of guinea-pigs in which the strain was being carried on parallel to the rats as a temporary measure, at the twelfth passage. The polymorphic nature gradually went also, but this could usually be brought back again by inoculating from the rats into guinea-pigs, although it only once has been possible—after the eighteenth rat passage—to bring back posterior-nuclear forms by this means. The occasion referred to, when the posterior-nuclear forms returned, occurred at the forty-fourth passage, after fourteen direct passages through rats.

This Strain M, because of its standard virulence, was being used at various times to test the effect of drugs as trypanocidal agents (the findings in this respect will be the subject of a separate communication). This question is introduced here because it was found that, after treatment with some of the drugs, posterior-nuclear forms were found to return. It seems suggestive that posterior-nuclear forms appear in a *T. rhodesiense* strain, when first isolated from a human case, will return when the strain passed direct through one species of laboratory animals is diverted into another species, and also can be made to reappear through the action of chemicals. The drug may act in one of three ways: it may act on the parasite, on the host, or on host and parasite together. The most feasible explanation, from our previous knowledge of the action of drugs in trypanosomiasis, seems to be that the drug has so altered the host and the resistance of host to organisms that the condition is analogous to the state of affairs produced by direct inoculation from one vertebrate species to another. The first drug to cause this return of posterior nuclear forms was one of a series of three arsenic compounds (arsenic in combination with a complex organic radicle) which were, judging by the length of life of the treated animals and the course of the infection in comparison with controls, of very slight trypanocidal effect. This reappearance occurred about the twentieth passage of the strain. At the forty-first passage they occurred in a rat treated with a substance called bistoval (bismuth acetylamino-oxyphenylarsinate), which is also very low as regards its curative value. Again, about this time posterior-nuclear forms reappeared on treating infected rats with tryparsamide. Lastly, while treating rats with halarsol (4-oxy-3 amino-phenyldichlorarsine) posterior-nuclear forms appeared in several animals; indeed by its use these types could be made almost to return at will.

The results of these curative experiments cannot be given in detail here, but it is germane to the present purpose to indicate one peculiar effect they have in altering the virulence of the strain. This may be exemplified by citing the cases of rats which had received a dose each of tryparsamide on the first day the organisms were found in their peripheral blood, that is to say, in the early stages of the disease. Very soon after the curative dose the organisms disappeared from the peripheral blood and remained undiscovered for about five months. At the end of that time one of the animals was killed and trypanosomes were found in the heart-blood and also in the brain. The other animal showed trypanosomes about a month later, and died shortly after. The manner in which the drug, given in the early stage of the disease, alters the virulence from a rapid, acute action to a slow, chronic one is most striking, and it is felt that this mode of action of drugs, especially the arsenicals, should be taken carefully into account by those engaged in the treatment of human cases (cf. Case H indicated above). Another detail worthy of emphasis is that after treatment and while in the chronic state the animals may carry trypanosomes in the central nervous system without showing symptoms. Halarsol-treated rats also have shown this change to a chronic state, and, in parenthesis, it may be said that of all drugs tried this, apart from "Bayer 205" and tryparsamide, is the only one which has shown really encouraging results.

Discussion.

It has been shown clearly that the initial transmission by mechanical means of *T. gambiense* and, in lesser degree, of *T. rhodesiense* from a human patient to laboratory animals, in the present instance rats, may be attended with certain difficulties. That there does exist a decided resistance to infection is well illustrated by the histories of the four strains of *T. gambiense* quoted above. In the Strain H2, for example, the first rat inoculated from the patient lived for six months, without showing trypanosomes in its peripheral blood, and it was only by a further passage that the trypanosomes became sufficiently numerous to be demonstrable. Thus it would appear that, as an aid to rapid diagnosis of trypanosomiasis in man, the inoculation of suspected blood into laboratory animals is a procedure the value of which is most problematical. There is no intention to suggest that it may be impossible to infect laboratory animals with *T. gambiense* from man, but rather to emphasize the peculiar latency which the organisms may exhibit in the new host. Wenyon (1926), discussing the pathogenicity of trypanosomes, states that the human strain of *T. brucei* (*T. rhodesiense*)

is easily inoculated from man into rats, in which it rapidly becomes virulent, "whereas *T. gambiense* in these circumstances may fail to infect the rat, though it usually does so, leading to a chronic type of infection characterized by the presence of a small number of trypanosomes in the blood at any time, the animals surviving for a year or even more." The occasions on which *T. gambiense* did not produce an apparent infection in rats possibly might be explained on the basis of a "latent" infection, a condition which can be compared aptly to "cryptic" trypanosomiasis.

This difficulty in establishing an infection in a new host (i.e., a host of a different species) is not confined to *T. gambiense*. Thus *Trypanosoma vivax*, as a rule, will not infect rats and guinea-pigs, but it has been shown by Blacklock and Yorke (1913) that rabbits under certain circumstances could be inoculated. *Trypanosoma congolense*, again, shows remarkable variations in its initial virulence (Yorke and Blacklock, 1923), some strains being virulent immediately, while others may become so only after many passages. Bruce and Coll (1913) report a most curious condition. Working with *Trypanosoma simiæ*, they found that the parasite was very fatal to monkeys, and while goats were susceptible, it was only in a much less degree. On attempting to inoculate back again from a goat to a monkey the latter proved to be refractory, indicating that passage through the goat had markedly decreased the virulence. On passing *Trypanosoma pecorum* through goats it was found also that it had lost its virulence to rats. Taute and Hueber (1919) inoculated themselves and 129 natives with blood from four horses and two mules containing trypanosomes like *T. rhodesiense*, and, apparently, failed to establish an infection in any of the human hosts, although controls, dog, goat, and rats, were infected. In this connection Yorke and Blacklock (1922) state as their opinion "that the majority of human beings is resistant and only occasionally susceptible to infections with trypanosomes," and, further, that "the experiments (of Taute and Hueber) simply confirm us in our belief in the relative immunity of man to infection with *T. rhodesiense*"

It would thus appear that the conclusion—that the human variety *T. rhodesiense* is distinct from the *T. brucei* of animals—arrived at as a result of this huge experiment of Taute and Hueber is open to criticism. In the first place there is the undoubtedly difficult factor of the transmission from one vertebrate host to another host of a different species to be overcome, and, secondly, there is the possibility that infection of the "latent" or "cryptic" variety analogous to that found in the initial transmission of *T. gambiense* from man to rat might have resulted. Had Taute and Hueber carried their experiment a step further by subinoculating blood from their original 131 into other human hosts the result might have been most interesting.

This state of affairs, in which trypanosomiasis is more or less dormant, is closely paralleled by that which sometimes follows drug treatment. In human patients there often may be clinical cure, the organisms may disappear from the peripheral blood, but exist in the cerebrospinal fluid. Attention was drawn to this phenomenon by Kleine (1924), who, by making lumbar punctures, found trypanosomes in eight out of twenty-one patients, about three months after the commencement of treatment with "Bayer 205." These patients displayed no symptoms, and their blood was free from parasites. The effect of drugs on experimental animals (carrying the Strain M, *T. rhodesiense*) in certain instances has been very similar to that in Kleine's group of cases. In one experiment in which the drug used was tryparsamide the animals lived for many months, and at death trypanosomes were found in the brain and heart-blood. While not attempting to indicate that this is the only or even the main mode of action of such drugs, it certainly seems possible that the character of the host has been so changed by the action of the drug as to produce a condition similar to that obtained by inoculating from a host of a given species into one of another species.

As a general rule mechanical transmission of a strain of trypanosomes results in a steady increase in virulence, until eventually the parasites become stabilized in their artificial host. The passage of such a strain from one host to another of a different species may render the parasites more deadly in their action. On the other hand, it may not do so. Thus if a strain of *T. gambiense* is kept in rats, transferred to a guinea-pig, and then by passage reintroduced into rats, at first it may be less virulent, but soon it may exhibit a greater virulence than previously. Thomas and Breinl (1905) found that a strain of *T. gambiense*, after passage through a baboon, showed an enhanced virulence to rabbits rats, cats, guinea-pigs and monkeys. In the present series mechanical passage of the Strain M, *T. rhodesiense*, resulted in a marked increase of virulence and rapid stabilization; the four *T. gambiense* strains on the other hand, showed marked differences, and, in one instance (Strain H2) even became progressively less virulent. Comparing Strain H with Strain H2, the latter having been isolated about two years after the former, there is, in this matter of virulence, a huge discrepancy. The suggestion is, therefore, that the patient H, during his period of treatment, was altered as a host, was rendered less susceptible, and lapsed from the acut condition into a state nearer approximating to that state of balance in which apparent harm is done neither by parasite to host nor *vice versa*, in brief into chronic, latent or almost cryptic trypanosomiasis. In any event the duration of its residence in the human host, or the action of drugs on host or parasite, had modified profoundly the virulence of the strain to laboratory animals.

As regards the morphology, continued direct transmission of one of the polymorphic group results in what is tantamount to monomorphism *T. gambiense* and *T. rhodesiense* gradually lose the short, stumpy forms and the intermediate forms, finally ending up as long, slender trypanosomes with a conspicuous free end to the flagellum.

Should there be passage into another species of host, whose susceptibility is very nearly but not quite the same as the original host, there is a tendency for the polymorphism to return. The degree to which the polymorphism will return may be influenced perhaps by the proportionate difference which may exist between the susceptibility of the hosts, i.e., the greater the resistance in the new host the more likely is the return. By transferring *T. gambiense* or *T. rhodesiense* from rats, in which the polymorphism has been lost, to guinea-pigs, the shorter forms can be made to return. The same effect, but in even more conspicuous degree, can be obtained in rats by means of drug treatment. It must be clearly understood that it is not intended to indicate that, after a series of mechanical transmissions, the trypanosomes will always continue to revert to their original state of polymorphism; their ability to do so becomes decidedly less and less the longer the strain is kept and the more numerous the passages. It is desired to emphasize that the tendency towards polymorphism is definitely aided by transmission into another species of host even by mechanical means, and that by the injection of drugs, a similar condition is brought about within the same species of host.

Edwards (1926), in an interesting paper, drew attention to the fact that in India surra is a very severe disease in equines. In bovines, on the other hand, *T. evansi* is much less virulent, buffaloes especially developing almost a complete tolerance to this trypanosome. Evidently, however, in certain localized areas sometimes it may acquire an increased virulence even to the buffalo. No adequate explanation has been advanced so far for these local epidemics, and, as surra normally is propagated by mechanical transmission, this factor cannot be incriminated as the cause of the outbreaks. With regard to African sleeping sickness, it has been suggested by Duke that the reason why the disease from time to time assumes epidemic proportions is to be found in the increased virulence resulting from rapid mechanical transmission. It is felt that mechanical transmission alone, even rapid transmission with alternation from the usual host, the wild game, to man, is insufficient to explain the sudden and devastating nature of the outbreak. It is within the bounds of possibility that the increased virulence might be due to the passage of the organisms through some special host, a host in which they may not produce any unusual virulence, but which might alter their future reactions in man.

Conclusions.

(1) *T. rhodesiense* can be inoculated easily from man to rats. In Strain M parasites appeared in the blood of the rat five days after the injection of human blood. Strains of *T. rhodesiense* rapidly increase in virulence, and, by subinoculation, soon become stabilized. Strain M became stabilized soon after the sixth passage.

(2) *T. gambiense* is much more difficult to establish in rats. Strains H2 and J took months to show in the peripheral blood of the original rats.

(3) *T. gambiense* may become rapidly virulent to rats (cf. Strain H, which soon became stabilized, eventually killing rats in three days); on the other hand, it may become even less virulent by passage, as in the case of Strain H2, in which the twentieth, twenty-first and twenty-second animals lived well over a year each.

(4) The variations in virulence of the three strains (Strains H2, J and MA) of *T. gambiense* followed a similar curve. First there was a sharp rise to the third and fourth passages, then a drop at the fifth and sixth. At the seventh or eighth passage there was a quick rise in virulence, which was maintained for about five passages, i.e., up to the thirteenth. Thereafter the fall in virulence was gradual until the nineteenth passage, when there was divergence.

(5) Two strains of *T. gambiense*, isolated at an interval of nearly two years from the same human case, showed marked variation in their virulence. The first to be isolated (Strain H) became rapidly stabilized, and in two years was killing rats in three days; the second (Strain H2) finally became less virulent, the last three animals all surviving for more than a year.

(6) This discrepancy in the relative virulence of these two strains (H and H2) possibly is due either to the difference of the lengths of time they inhabited the human host, or to the treatment which the patient H had received in the interval before the second strain was isolated.

(7) *T. gambiense* may exhibit a peculiar latency, lying dormant, as it were, in subinoculated rats. This latency has been compared with "cryptic" trypanosomiasis. For example, two rats inoculated with Strain J showed trypanosomes in their blood on one occasion sixteen days after inoculation, and did not show again for about five months. A similar latency may be observed in human cases as a result of drug treatment. When rats carrying the virulent, stabilized Strain M are treated with drugs, especially the arsenicals, the trypanosomiasis similarly may be dormant.

(8) By mechanical transmission a strain of trypanosomes, maintained in a series of hosts of the same species, *usually* will exhibit increased virulence; on the other hand, the virulence may actually decrease, as in Strain H2, *T. gambiense*. By passage through a host of a species different from the usual the virulence of a strain may be markedly modified, either diminished or increased.

(9) It is suggested that in trypanosomiasis, among other actions, drugs may change the character of a host. Further, that such alteration in the host almost may be comparable to that obtained by injecting organisms from a host of the species in which the strain is usually mechanically maintained into a host of another species. This is exemplified in the patient H. Before treatment the organisms isolated from his blood were very virulent; after treatment they became very avirulent to the rats. In rats carrying *T. gambiense* (Strain MA) which were treated with halarsol, the strain rapidly became much more virulent during subsequent passages.

(10) When either *T. gambiense* or *T. rhodesiense* are transferred mechanically from man to rats, at

first the trypanosomes exhibit a well-marked polymorphism, with, in the case of the latter, the appearance of posterior-nuclear forms, but later this is lost. Up to a certain stage the polymorphic nature of the parasites can be made to return by transferring the strain from the usual host into a host of another species.

(11) A return of the polymorphism and, in the case of *T. rhodesiense* posterior-nuclear forms, can be brought about by the action of drugs. The suggestion is that the return to the polymorphic character is not due so much to the action of the drug on the parasites as on the host.

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THE TREATMENT OF TROPICAL SORE.

Cutaneous ulcerations of granulomatous nature are prevalent in many warm countries, in which, however, they usually appear to be endemic within certain limited areas. This local prevalence has caused various local names to be applied to this

condition in large numbers, as evidenced by the following synonyms which have been employed for this condition, namely: Delhi boil, Aleppo boil, Biskra boil, Baghdad boil, ulcera du Bauru, bouton d'Orient, ulcère d'Orient, chancre du Sahara, dermite ulcéreuse circonscrite, Endemische Beulenkrankheit, bottone d'Orient, Godownick, Il-jarassy, Tschiban, Dous-el-Kourmati, Ghisud, Habb-es-Sanawi, Habb-es-Sanah, Bess-el-Temur, Salek, Pascha-churdj, Afghan jara, Jaman dyscharagan, Taschkent jarassi, Taschkent ulcer, mycosis cutis chronica, lupus epidemicus, endemic boil disease, granuloma endemicum, furunculus orientalis, Pianbois, parasitic granuloma, Sudan nodules and Leishman nodules.

To cover all this multiplicity of names for what is essentially one and the same condition the terms oriental sore and tropical sore have been employed. As, however, the disease is always manifest as a cutaneous lesion produced by a definite specific infection by a species of Leishmania, a better and more suitable name for this condition is cutaneous leishmaniasis. The genus to which this species of organisms belongs was created by Ross in 1903, under the name of Leishmania, which is defined by Castellani and Chalmers as "Herpetomoninæ, living principally in endothelial cells, but also found in leucocytes and in the peripheral blood of mammals as small, oval cytoplasmic masses with trophoand kineto-nuclei, and developing into flagellate bodies in cultures."

Three species are known to occur in man, morphologically similar but pathologically different, namely: *Leishmania donovani* Laveran and Mesnil 1903, causing kala-azar; *Leishmania infantum* Nicolle 1908, causing infantile splenomegaly; and *Leishmania tropica* Wright 1903, with its variety *Leishmania americana*, causing cutaneous leishmaniasis or tropical sore and espundia or mucocutaneous leishmaniasis.

The infectivity of this organism has been definitely proved by direct inoculation both in man and animals.

Neither race, age, sex, occupation nor social condition materially affects susceptibility to infection. Insect-carriers have long been subject to suspicion, but up to the present no insect has been definitely demonstrated to be the true host of *Leishmania tropica*.

After an incubation period variously stated in days, weeks or months ulceration of the skin commences and slowly extends so that it may eventually occupy an area several inches across, though usually it presents a diameter of about one inch. After a period varying from two to twelve months, or even longer, healing commences by granulation, but the process is often slow and interrupted. Healing is eventually complete, but much scarring may result. It would appear that a tropical sore produces a definite immunity, so that, as a rule, second attacks do not occur.

Many and various are the forms of treatment which have been advocated for this condition. Excision of the sore has been advised. Various antiseptics have been employed topically, either as lotions, powders or ointments. These include perchloride of mercury, carbolic acid, permanganate of potassium, tincture of iodine, boric acid, silver nitrate, protargol and methylene blue. Salvarsan and atoxyl have been used without any good result. Ionization, X-rays, light treatment and carbon-dioxide snow have all been more or less favourably reported upon. More recently good results have been recorded from the injection into the base of the sore of gradually increasing doses of emetine hydrochloride.

The most successful results, however, have resulted from the use of tartar emetic, which has been described as a specific for this condition, and of phosphorated oil. The former is best administered in the form of intravenous injections, using a one per cent. solution in saline solution or in distilled water. It may also be given by intramuscular injection, but this method suffers from the drawback that solutions of tartar emetic, as of other antimonial salts, are painful and apt to induce the formation of abscesses. Tartar emetic may also usefully be administered orally, especially in conjunction with intravenous or intramuscular injections. Lastly, tartar emetic may be applied locally as a one per cent. ointment or a one per cent. lotion, but the local application of tartar emetic in powder, which has been recommended, should be avoided on account of its extreme painfulness.

Phosphorated oil in the form of the oleum phosphoratum of the British Pharmacopœia, was first advocated by Castellani in 1923. He observed that the use of this preparation by subcutaneous injection was practically painless, and provided small doses were employed there was no risk of phosphorus poisoning—either immediate or delayed. Good results have been recorded from its use in cases of tropical sore. It is essential that the phosphorated oil should be of recent preparation. Its mode of employment is as follows: When the ulceration is well marked the oil is applied directly to the fundus and margins of the ulcer after removing the scab, and this simple treatment alone was found to answer admirably in cases recently recorded by Kelaart. When the lesion is a nodular one and there is little ulceration, in addition to the direct application of the oil subcutaneous injections should be given. In carrying these out a sterile 20-minim all-glass hypodermic syringe is used; three to five minims of the recently prepared phosphorated oil are drawn into the syringe and then injected into and around the lesion by inserting the needle of the syringe into the nodule and under the skin round its margin; two or three drops of the oil are then dabbed on the surface of the ulcer. This procedure is repeated once or twice a week, according to the amount of local reaction which ensues. If this is severe, which only very occasionally happens, the injections should be discontinued for a time and hot boric fomentations should be applied.

Subcutaneous injections of phosphorated oil have also been employed in other conditions such as rickets and osteomalacia, and, as an adjuvant to

quinine and arsenic, in certain cases of chronic malarial cachexia. It has further been suggested that this method of treatment might also be tried and might be found of benefit in other forms of leishmaniasis, as well as in certain cases of ulcer of non-leishmania origin, as, for example, granuloma inguinale, ulcus tropicum and certain persistent tropical ulcerations of obscure origin.

Finally, it may be pointed out that phosphorus possesses powerful poisonous properties, and that its special tendency is to damage the liver, which, though it may be a delayed result, should never be lost sight of. The administration of oleum phosphoratum, therefore, always demands the exercise of the greatest care, and in its use every possible precaution should be taken.

F. E. T.

Annotations.

The Cultivation of Herpetomonas muscarum (*Leidy* 1856) *Kent* 1881 *from Lucilia sericata* (J. J. Drbohlav, *The Journal of Parasitology*, June, 1926).—A herpetomonas requiring a medium of low hydrogen-ion concentration, i.e., pH 5·6 to 6·4, was isolated in pure live culture from the green-bottle fly, *Lucilia sericata*. It was found in 83·4 per cent. of the specimens examined. On account of the group specificity of herpetomonads obtained from muscoid flies, and from the results of Becker's and other experiments, as well as from their morphological identity, they are considered to be of the species *Herpetomonas muscarum* (Leidy 1856) Kent 1881. This species should be considered as uniflagellate. In division a precocious growth of the second flagellum gives the impression that the parasite is biflagellate. Forms without nucleus found also in pure culture may be explained on the basis of atypical division. Large multinuclear forms, without multiple nuclei and parabasal bodies developed in cultures, being sometimes ten times as large as usual. These probably result from a failure of the cleavage of the cytoplasm to keep pace with nuclear division. No intracellular forms of *H. muscarum* were found. The failure to find this species on microscopical examination of the ovary or in cultures inoculated with ovarian tissue, indicates that it is not commonly transmitted through the egg of the fly.

Emetine Periodide in the Treatment of Schistosoma hæmatobium Infections amongst West African Children (R. M. Gordon, *Annals of Tropical Medicine and Parasitology*, August 13, 1926).—An examination of 81 children at the "United Brethren in Christ" Missionary School, Jiama, Nimmi Korro, showed that 43 of them were suffering from *Schistosoma hæmatobium* infection of the bladder; of these 43 cases, 28 were severe cases (passing many live eggs and much blood in every sample of urine examined). These were divided into equal classes. Class I received emetine hydrochloride treatment given subcutaneously; Class II, emetine periodide treatment given by the mouth. The average age of the emetine hydrochloride group being eleven years and six months, and that of the emetine periodide group nine years and seven months. The result of the treatment seems to be quite uninfluenced by the age of the child.

The oral administration of emetine periodide cleared up the urine of children intensely infected with *S. hæmatobium*, just as quickly and almost with as great certainty as subcutaneous injections of emetine hydrochloride. Certain ill-effects were noted as the result of subcutaneous injections of emetine hydrochloride and great difficulty was experienced in making the children report for treatment. No ill-effects followed the oral administration of emetine periodide, and no difficulty whatsoever was experienced in getting the children to attend for, and take, this drug.

Medical Aspects of Life Insurance in India, with Special Reference to Calcutta (E. Houseman, *Indian Medical Gazette*, June, 1926).—The risk of Indian residence is steadily decreasing for both Europeans and Indians. Taken as a whole, Indians are considerably worse risks than Europeans and insurance companies probably act wisely when they encourage endowments rather than whole-life policies for Indians. Indians are usually men of shorter stature than Europeans and their corresponding weights generally are lower. This is particularly noticeable in the younger men, but older men are inclined to become heavier than Europeans. Indians who are overweight should be regarded unfavourably, they are generally prosperous, lead sedentary lives, and eat carbohydrates to excess.

Respiratory diseases, and more particularly pneumonia and phthisis, are very fatal diseases for Indians. The phthisis mortality shows no tendency to decline and the disease is usually of a very acute type. It is more fatal for women than men, probably owing to the *purdah*. Dysentery and bowel complaints are very fatal for Indians, but the mortality from these diseases has declined considerably during the last thirty years. The mortality from fevers declined rapidly in Calcutta up to 1908, since when it has remained fairly constant. Hydrocele is especially prevalent amongst Indians and is an occasional cause of death. Glycosuria is not very prevalent amongst Indians until they reach middle age, after which its incidence increases and it becomes more fatal for Indians than for Europeans. Indians tend to have a higher blood-sugar than Europeans. Owing to the infrequency of acute rheumatism and scarlet fever, valvular disease of the heart is not so common amongst Indians as among Europeans, but malignant endocarditis and myocardial degenerations are common. Pyorrhœa is very common amongst Indians, so much so that after middle age few seem to be free from it.

Principles in the Testing of a Cure (H. W. Acton, *Indian Medical Gazette*, June, 1926).—Cures may

be of two kinds, permanent or temporary. In the latter condition the causative agent of the disease is still present, but not in sufficient numbers to give rise to symptoms. Permanent cures may occur with complete recovery of the tissues, or may be incomplete with impairment or loss of function. In every test of a cure, the data of composition of the population tested should always be given as regards its important ætiological factors such as age, habits and customs, &c., since these factors may profoundly influence the course of the disease. The two populations compared, those under test and the controls, should be similar in every respect; e.g., with regard to numbers, homogeneousness, &c. The percentage mortality or cure-rate is obtained by observations on 100 individuals; not by elevating observation on digits into percentages. A homogeneous population under test can only be secured by avoiding bias, and paying attention to the law of chance sampling. The testing and control experiments should be carried out under identical conditions in order to avoid obtaining the results of only partial correlations. Also tests for a cure should, if possible, be carried out in non-infective areas, with regard to protozoal diseases especially, in order to exclude the chances of re-infection. Only differences between the two groups of a significant order should be considered; e.g., those outside the range of chance sampling, or partial correlation.

The permanency of a cure can only be tested by time, the continued well-being of the patients, and the effect of the introduction of the cure on the mortality rate for a given disease in the general population. In cases of rare diseases, where large numbers of observations are not possible, one has to rely on diseases which show chronicity before treatment, high mortality rate, and the rapid disappearance or arrest of the diseases when under treatment. The relative value of a modification of treatment, e.g., of the comparative value of the dry cord method and the dilution method of Hoghyes in anti-rabic treatment, or of the different pentavalent compounds of antimony in the treatment of kala-azar, can only be tested on a large scale. Consideration must also be paid to the relative toxicity to the body of the different compounds used, apart from the therapeutic value.

Studies on the Serology of Leprosy. III. The Kahn Precipitation Reaction in Leprosy (E. V. Pineda and E. R. Pineda, *The Philippine Journal of Science*, July, 1926).—One hundred non-leper sera, obtained from the venereal clinic and outpatient department of San Lazaro Hospital, were examined for the Wassermann and Kahn tests. There was an agreement in the results of 93 per cent. One hundred leper and leper-suspect sera were tested by the Wassermann reaction and by the precipitation test of Kahn. There was very close agreement in the results of the Wassermann and Kahn test, with a slight sensitiveness in favour of the Kahn test. The Wassermann and the Kahn tests in leper patients are generally negative. There was observed in 1 per cent. of leper and leper-suspect sera, positive Wassermann reaction without any history or signs of syphilis or yaws. In confirmed leper sera, the Wassermann test was positive in 1·23 per cent. of the cases without any signs or history of syphilis or yaws. Kolmer and Denny found that 7·32 per cent. of non-syphilitic leper sera gave falsely positive Wassermann reaction. The Kahn test was positive in 5 per cent. of leper and leper-suspect sera without any signs or history of syphilis or yaws. In confirmed leper sera, the Kahn test was positive in 6·17 per cent. of the cases without any sign or history of syphilis or yaws. As far as lepers are concerned, the Kahn test is of greater value than the Wassermann test in excluding syphilis or yaws, and of less value in establishing the diagnosis of these two diseases.

The Deodorization of Coconut Oil (W. L. Brooke, *Philippine Journal of Science*, June, 1926).—Methyl-nonyl-ketone was isolated from the product obtained from the deodorization of coconut oil, thus confirming the finding of Haller and Lassieur. Its presence is established by the preparation and identification of the oxime, dioxime and semicarbazone. Most of the non-saponifiable substances distil over in the first few hours of deodorization. The yields of the non-saponifiable constituents obtained from crude coconut oil in the laboratory and from the condensed deodorization sludge that was obtained from the factory are described by the author. The non-saponifiable constituents also contain alcoholic compounds. Two analyses of the crude acid sludge are also described.

Current Literature.

THE AMERICAN JOURNAL OF TROPICAL MEDICINE. July, 1926.

Developments in Anthelmintic Medication (M. C. Hall).—Up to less than half a century ago anthelmintic medication underwent a very slow evolution, then there was a rather rapid acceleration in the way of developments, and the last ten years, which covers critical experimental investigations, is considered the third stage in the development of this subject. Anthelmintics were first given consideration centuries ago, when natives associated the passage of worms with foods and other substances previously eaten, and many kinds of plant material came to be recognized as anthelmintic in nature. The oldest anthelmintic now in use is the male fern, known to the ancient Greeks. It was used in the Middle Ages and then appears to have been forgotten until the eighteenth century, when it was restored to use. Interest was revived in anthelmintics on the discovery of the human hookworm, *Ankylostoma duodenale* (Dubini, 1843), but the first serious consideration was not until 1881, when Perroncito tested male fern and other anthelmintics on

hookworm larvæ *in vitro*, and on the results with male fern administered this drug to human patients with a fair degree of success. In the same year Bozzolo proposed thymol which became the standard drug for the treatment of ankylostomiasis, and held this position for a quarter of a century. In 1904 beta-naphthol was proposed by Bentley, and is still in use. Favourable reports were received from Brazil on the use of chenopodium in the treatment of ascariasis, but its use was not favoured in Europe until 1913, when Schuffner and Verwoot gave chenopodium an adequate test in ankylostomiasis and reported favourably on it. In the following decade it took first place and was used extensively. In 1921 carbon tetrachloride was proposed by Hall for the removal of hookworms and was used with great success. In 1925 a new drug was proposed by Hall and Shillinger, tetrachlorethylene, a chemical closely related to carbon tetrachloride, claiming that it is safer and more effective than the latter. Recent developments along the lines of correlation of egg-counts with worms present by the methods of Stoll and Clayton Lane have materially added to the accuracy of testing the value of anthelmintics, but this is still an open field for investigation and promises definite and valuable results.

Some Atypical Cases of Yellow Fever in Salvador (H. Hanson).—Yellow fever epidemics appear to be no exception to the rule that there are always some cases in epidemics in which the so-called classical symptoms are missing. The author describes four cases which occurred in the recent outbreak of yellow fever in San Salvador, Central America. Three of these cases had been vaccinated with the Noguchi vaccine against yellow fever and they were all taken sick within fourteen days after the second inoculation, i.e., before the elapse of the period required for the establishment of immunity. The three cases presented a mild type of the disease. The other case had not been vaccinated and presented the type of the disease with cerebral manifestations which usually is fatal. The symptoms rapidly subsided after the intravenous administration of Noguchi anti-yellow fever serum. The important points in the treatment of these cases involved (1) complete rest in bed; (2) starvation; (3) catharsis; (4) administration of water, in small quantities and frequently; (5) seclusion of the patient. Morphine or quinine should never be used in yellow fever therapy.

Histoplasmosis of Darling with Report of a Case Originating in Minnesota (W. A. Riley and C. J. Watson).—Histoplasmosis of man has been known hitherto only from the three cases reported by Darling, from Panama. A fourth case is reported —that of a woman who had not been out of the State of Minnesota in forty-two years. The case was clinically identical with those reported by Darling: greatly enlarged spleen, pseudo-granuloma of the lungs, emaciation and anæmia. In phagocytic cells of the lung, liver, spleen and lymph nodes were enormous numbers of the organism described by Darling under the name *Histoplasma capsulatum*. As pointed out by Da Rocha Lima (1912), this organism is evidently closely related to *Cryptococcus farciminosus* Rivolta, the cause of epizootic lymphangitis of horses and man. While Da Rocha Lima and most recent workers regard this organism as a yeast, Ota (1925) places it in the genus *Grubyella*, among the hyphomycetes. Most of the mycoses which become systemic are rapidly fatal. This condition was systemic and chronic for many years. The available evidence does not support the view that histoplasmosis of man is identical with epizootic lymphangitis. In clinical picture and in size and morphology of the organisms, it differs from the torulosis of Stoddard and Cutler, cases of which had been noted especially in the vicinity of Chicago, Illinois.

The probability is that in histoplasmosis and in epizootic lymphangitis we are dealing with two very closely related species of *Cryptococcus* (Grubyella), one causing systemic infection and one largely superficial. An analogous situation is afforded by *Leishmania donovani* and *Leishmania tropica*. The finding of this case emphasizes the importance of considering the possibilities of the disease in connection with obscure cases of splenomegaly in temperate as well as in tropical zones.

Observations on the Emergence of Anopheles Mosquitoes (G. H. Bradley).—During the mosquito breeding seasons of 1921, 1922 and 1924 observations were made near Mound, Louisiana; a total of 904·9 square yards of water surface in selected anopheles breeding areas was covered by nets and 585 adult anopheles, emerged therein, making an average daily emergence of 0·653 per square yard. The nets were located in areas which showed a higher larval rate, as determined by larval counts, than is generally found in the anopheles breeding areas of the region. An increase in the number of larvæ present in the selected areas did not cause a proportionate increase in the rate of emergence. This may have been caused by a scarcity of suitable food in the concentrated areas, or by the activities of certain enemies of the larvæ. The females of anopheles were found to emerge in somewhat greater numbers than the males. A discussion is given showing that this condition is usually met with among anopheles, although approximately equal numbers of the sexes have been observed at certain times, and at others, a large preponderance of males has been recorded.

Observations on Dientamœba Fragilis (R. Kudo).—A case is recorded in which *D. fragilis* was found in the stools of a patient in Urbana, Illinois. This protozoan was first observed by Wenyon, 1909, and has since been found in cases in England, New York, Holland, Manila, Hamburg and Baltimore. It has been well studied and described by Jepps and Dobell (1918). The number of amœbæ present in this case was very great. Binucleate amœbæ were found in only 12·2 per cent. and uninucleate forms in 87·8 per cent. of 2,000 individuals observed at random. Nuclear division is described.

Colonial Medical Reports.—No. 186.—Bengal (*contd.*).

The inundation of the country during the monsoon is unfavourable to the multiplication of anopheles mosquitoes, in the first place, because flooding reduces the dangerous "water-edge" which affords safe cover for mosquito larvæ; in the second place, because owing to the large surface exposed to the rays of the sun the temperature of the water tends to rise so as to be exceedingly unfavourable to the life of anopheles larvæ; and in the third place, because the physical and possibly the chemical character of river water is inimical to anopheles larvæ. Observations show that anopheles larvæ are rarely or never found far from the grass-grown or weedy edge of collections of water; that they cannot stand a wet temperature much above that of the wet bulb thermometer and are rapidly killed by a temperature of 104° F.; and that they do not flourish in water containing fine silt in suspension. River water in the flood season also contains a very large amount of carbon dioxide (CO_2), so much so that its reaction tends to become acid, and this possibly affords a further explanation of the fact that anopheles larvæ do not flourish in river water during the flood season.

Recent Investigations on the Breeding of Anopheles Larvæ.—Investigations by Hodgson and King serve to throw a new light upon the rationale of phenomena of the kind referred to, enabling us to understand how irrigation may, in certain circumstances, reduce malaria, and why, on the contrary, a reduction of the surface water in deltaic areas may bring about an increase of the disease. The following passage is extracted from Hodgson's note in the proceedings of the Lucknow Sanitary Conference, 1914:

"Taking the mosquito in its larval existence, we found that the optimum temperature for anopheles lay between 68°-78° F. Temperature above 80° F. became more and more unsuitable, while temperatures of 95°-104° F. were rapidly fatal. In nature during the monsoon at Delhi in August, and in Madras in November, we found the surface of pools to vary from 73°-104° F., the difference being due to the following important facts:

(1) The coolest pools were very small pools lying amongst grass.

(2) The edge of the pool in the daytime was cooler than the centre.

(3) The surface layer is often 3° or 4° hotter than the water four or five inches down at midday.

(4) The water lying at the shallow edge, round grass stems, is the coolest part of a pool.

(5) When the average temperature of pools had risen to 90° or even 100°, falling rain, both at Delhi and Madras, was found to be 73° to 77° F. during the monsoon.

(6) The river at Delhi, even after long drought, never rose above 87° F. at midday.

(7) Well water varied from 80° to 82° F.

(8) The sea at Madras in the monsoon was 80° F.

(9) Small hoof-marks in grass might contain water 9° F. cooler than a large pool six inches away, particularly during hot dry weather.

"An anopheles mosquito lays her eggs in that type of pool which is coolest at the time. The struggle for existence rapidly increases above 80° F. and temperatures such 104° F. are fatal to every single larva in less than eighteen hours, though this is a temperature at which some pools have been found in nature. In the Terai in October, water varied from 65° F. to 78° F. on the two days we examined it, and anopheles were breeding in millions. The great destroyer of mosquito larvæ is nature, and her principal means is raising the temperature of the water."

It will be seen from these observations that small collections of water and those possessing a large ratio of weedy edge are far more dangerous than large water surfaces, because they invariably possess a lower temperature much more suitable for mosquito larvæ than the high temperature to which large collections of water speedily become raised. This fact helps to explain the beneficial effect of flooding upon the prevalence of malaria. When water is admitted in large amount to the surface of a low-lying country, all the small pools are converted into large ones; on the one hand the ratio of dangerous edge is greatly reduced, and on the other hand the temperature of the water is speedily raised, with the result that the output of anopheles mosquitoes is restricted.

Indirect Effect of Embankments on Malaria.—Embankments that prevent flooding may thus be a direct cause of malaria, but they also tend to increase the malaria of delta tracts in an indirect manner. The cessation of inundation, as we have seen, causes a decline of agriculture, leading to economic stress among the population. It causes also a coincident increase of anopheles mosquitoes, leading to the spread of malaria infection. The final result is an extraordinary exaltation of malarial disease, signalized by the occurrence of a serious epidemic. This epidemic malaria in turn causes depopulation, partly by increased mortality and reduced fecundity and partly by stimulating migration. And depopulation introduces a further vicious cycle, causing a still further increase of malaria and still greater depopulation, until in badly affected localities the population is eventually either entirely obliterated or reduced perhaps to a tenth of its former number, the sites of once densely populated towns and villages quickly lapsing into almost impenetrable jungle.

Why the Danger of Embankments was not formerly Understood.—When the embanking of the delta tracts was begun, first as a measure of flood prevention, as in the case of Burdwan, Murshidabad and Nadia, then for roads, as in case of Jessore, and finally owing to the construction of railways, few persons realized that the process was fraught with danger. Even after attention had been called to the outbreaks of fever that followed the construction of embankments, the term "water-loogging," which was frequently employed without having been clearly defined, appears to have led to a misunderstanding of the situation. In those days the cause of malaria was unknown, but medical authorities were wont

to ascribe it generally to "water-logging," meaning thereby a super-saturation of the soil with water. Rajah Digambar Mitter, when seeking to explain the epidemics of malaria that occurred in association with the construction of embankments, suggested that they were due to "water-logging," produced by these embankments. By "water-logging," however, he appears to have meant "obstructed flow" rather than super-saturation of the soil. It may be remarked that the term is frequently used by Bengalis in the former sense at the present time. Obviously, obstructed flow may occur either in association with excess or as a result of deficiency of water; but in Bengal it is deficiency rather than an excess of water that is especially dangerous, and that is concerned in particular with the obstructed flow so often observed in the case of the silted-up channels of malarious areas. When, however, the medical men and engineers, who were asked to investigate the epidemic fever, sought for evidence of water-logging, they naturally looked for evidence of the saturation of the soil, which that phrase ordinarily implies, and, failing to discover much evidence of this, they declined to admit that water-logging was the explanation of the epidemic fever; whereas, had they inquired into the question of obstructed flow and a reduction of the surface water in the affected tracts, they would have found, as in fact many of them did find, evidence of this on all sides. Even in comparatively recent times, a similar misunderstanding has often prevented an appreciation of the real facts. Recently a serious increase of malaria in a village near the Sara Bridge followed the shutting out of flood water by the construction of an embankment. In reply to an appeal from the District Magistrate, the engineers who were responsible insisted that the village must in reality have become more healthy, rather than less so, because, owing to the embankment, it was much drier than before. In this case it was true that the village was drier than formerly, but it was also true that the breeding of anopheles had been greatly increased in consequence of the numerous small isolated collections of rain water that had taken the place of the former general flooding of the village site, with the result that malaria had greatly increased.

The Effect of Superabundance of Water on Malaria.—As a matter of fact, few people are aware that for centuries it has been known that the partial drying up of large swamps often renders them intensely malarious, and that in low-lying deltaic tracts a heavy rainfall and the occurrence of inundations prevents malaria and serves to keep them healthy. "In some marshy countries," says Davidson, "a heavy rainfall diminishes the prevalence of fever by covering the marshy ground with a protective sheet of water. Thus, in the Netherlands, it has often been remarked that rainy years are healthy years, while hot and dry seasons are feverish." "Very heavy rain," says Scheube, speaking of conditions affecting malaria prevalence, "has a deterrent influence on naturally damp soil. . . . . At the height of the rainy season. . . . in Deli, in Sumatra (Martin), and New Guinea (Schellong), the minimum number of cases of illness is notified." He explains this by observing that "a thorough soaking of the soil is deleterious to the development of the mosquito." "In many regions," says Craig, "where abundant rains occur, malaria is rare, even though the anophelines are present. This is explained by the fact that in such regions the rains are so heavy and continued that the breeding places of mosquitoes are washed out and ova and larvæ do not have a chance to develop, or that no infected individuals are resident in the locality. In the former instance an unusually heavy rainfall may act as a protection against malaria."

The passages quoted above show that it has long been recognized that in low-lying countries a superabundance of surface water, far from being harmful, may exert a beneficial influence upon malaria. And authorities like the late Professor Angelo Celli and Professor Julius Mannaberg have always regarded flooding or "covering by water" as useful measures for the control of the disease.

Embankments a first step in Reclaiming a Delta.—The first effect of constructing embankments in low-lying areas subject to inundation from rivers is to reduce very largely the total volume of water present on the surface of the land during the actual flood season, which in hot countries is the malarious season. This reduction of the surface water causes a great increase of malaria. The second result is that the amount of rain water that is held up after the flood is over and the water-level of the rivers has fallen, may be considerably increased because the embankments tend to check the "run-off" from the land surface. This does not usually affect malaria very much, because the season of new infections is nearly over, but it damages agriculture. Embankments, therefore, cause an extraordinary change in the entire regime of a delta. Many deltas, it is true, have been reclaimed and put under pasture or dry cultivation; and this reclamation has necessitated the construction of embankments. But it has been necessary in all such cases to provide special systems of drainage, usually by means of pumps. Examples of this are to be seen in the case of the Po, the Rhine and the Scheldt, and in the Fen district of England. The construction of embankments is often therefore a first step in the reclamation of a delta. But deltas that have been embanked without any corresponding reorganization of their drainage are only partially reclaimed. The situation of the population of a delta that has been left in this condition is deplorable in the extreme. Agriculture is seriously interfered with. The cultivators cannot grow the same amount of wet crops as formerly, owing to the lack of fertilizing river silt and the fact that in some portions of the country there is too little water while in others there is actual water-logging; and they cannot grow day crops because drainage by gravity is not sufficient for this purpose. Above all the people are exposed to recurring attacks of epidemic malaria as a result of the partial reclamation of the country by embankments.

Partial Reclamation of Low Lands always conduces to Malaria.—Throughout all ages history is unanimous on this point, that the partial reclamation of swamps invariably leads to an appalling increase of malaria.

"No one in Holland," says Wilson, speaking of the influence of malaria in causing disease, "has any doubt as to the origin of this power, but ascribes it uniformly to the drainage of some lake. . . . It was even foretold by several writers that fevers would result from draining the Lake of Haarlem, as took place in the years 1608, 1641 and 1779 from draining several polders. At Haarlem the summer of 1779 was extremely hot and a fever epidemic appeared which continued for three years. It was ascribed to the draining of several polders." "So long," he adds, "as the Lake of Haarlem was a lake, or mere, so long were its banks healthy. But drain it partially and you must be prepared for the result. There is no middle course. It must be arrested by the hands which drained or attempted to drain it and converted into healthy pasture land or a wheat field. . . . . The effects of partial or incomplete drainage have ever been the same."

The influence of partially reclaiming swamps or lakes on the health of the inhabitants was frequently discussed during the last century, especially in connection with the draining of the low-lands of Biensten and de Wonner, &c. The reclaiming of the La Chartreuse swamp near Bordeaux is also a classical example. After the work was commenced in the summer of 1805, an appalling epidemic broke out which caused 18,000 cases of pernicious malaria and 3,000 deaths. A similar occurrence also took place in the neighbourhood of Peterborough about 1860, following the reclamation of the Whittlesea mere. In his report to the Privy Council on this outbreak, Dr. Paley remarked, "The first effect of the improved drainage of the large Fen districts has been rather to increase the prevalence of ague." In Bengal, the construction of embankments in the delta tracts has been followed by similar results. But in this case the evil has been infinitely greater. In all the other instances mentioned, reclamation was finally completed, so that the reclaimed areas became rich farm lands, from which the local population eventually derived great benefit. But in Bengal there has been no attempt to turn the rice swamps into wheat land and pasture. On the contrary, natural irrigation with river water has been stopped and drainage obstructed. And the inevitable result has been agricultural deterioration and epidemic malaria. It must not be supposed that those responsible for the embanking of the country had any idea that such results would follow. They aimed at increasing the welfare of the community by preventing floods and improving communications. But the disastrous results of this policy has at last become apparent, and every endeavour must now be made to prevent the continuance of the error and to remedy, as far as possible, the evils that have occurred through past mistakes.

How to Prevent the Extension of Malaria in Bengal.

The Remedy for Malaria in the Delta Tracts of Bengal.—The great increase of malarial disease that has taken place in many deltaic areas in Bengal is inextricably bound up with a coincident decline of agricultural production owing to diminished natural irrigation and impoverishment of the soil. The common origin of these associated evils is to be sought in the decay of the river systems of the delta tracts, accelerated by the embanking of certain main channels, the mischief being further greatly intensified by the construction of thousands of miles of raised roads and railways. At present the natural divisions of Western and Central Bengal are chiefly affected; but certain deltaic tracts in Northern Bengal have long been suffering in a similar manner; and vast areas in Eastern Bengal that have so far remained comparatively immune both from malaria and from the agricultural decline that invariably accompanies an increase of the disease in rural areas, are now seriously endangered owing to the rapid extension of embanked communications of all kinds. At the present moment, therefore, Bengal is faced with two problems: (1) how to avert the threatened extension of malaria, especially in Eastern Bengal; and (2) how best to remedy the malaria already existing both in that and in the other natural divisions of the province.

How to Avert the Extension of Malaria in Healthy Deltaic areas.—Deltaic areas that are as yet free of malaria are characterized by possessing rivers that are still active, spilling over their banks in the flood season and distributing their water through the numerous channels which intersect the country. As a result of the free supply of flood water, these areas are subject to inundation, but as they have few embankments, the water passes freely over the surface of the country doing no harm and bringing wondrous fertility to the soil. At the end of the wet season, the river levels fall and the flood water flows away from the surface of the land leaving the soil well-drained and healthy, alike for crops and for human beings. It must always be remembered that these favoured localities, although they now enjoy a wonderful immunity from malaria, do so only because of the superabundance of surface water that covers the country during the wet season. Moreover, they are in a state of unstable equilibrium. For if conditions in respect to the flow of surface water over the country are interfered with so as to diminish the normal amount of flush and permit instead of the formation of small pools of relatively stagnant rain water so favourable to the breeding of anopheles mosquitoes, these healthy, prosperous districts are capable of becoming intensely malarious. To prevent deltaic areas of this kind becoming malarious, the integrity of the rivers and smaller water-channels must be maintained, their respective spill areas preserved, and normal inundation encouraged. Above all, the erection of embankments of any kind, whether for railway or road communications or other purposes, must be absolutely pro-

hibited until such time as it is possible to devise a method of construction that will not interfere with the natural irrigation or the drainage of the country, and will neither damage agriculture nor the health of the community. The consequences of embanking deltaic areas are so exceedingly serious, both to cultivation and the public health, that once the danger has been recognized, the obvious course to follow, if these consequences are to be averted, is to stop the further construction of embankments. But action in this direction must be combined with a number of other measures if it is to do more than postpone for a short period the threatened evils of malaria and agricultural decadence. It will be necessary, for example, to examine the rivers and other water-channels with a view of adapting them, if possible, both for irrigation and for purposes of communication. In the latter connection it must be remembered that it is often the urgent demand for improved communications that has led in the past to the heedless embanking of the country, a process fraught with results disastrous alike to health and agriculture.

The systematic examination of the rivers and water-courses in every district must be further supplemented by a survey of their local spill area and the lines of interior drainage. All embankments that already exist must also be carefully scrutinized with a view to determining what effect they have upon the natural irrigation and drainage of the locality and whether the water-ways provided are sufficient for this double purpose. Lastly, the movements of the ground water must be watched in order to determine the level of the local water-table and its seasonal variations, and to discover what influence these fluctuations have upon the growth of crops and the condition of the public health.

Summary of Measures required in Relatively Healthy Deltaic Areas.—Briefly summarized the measures that must be adopted to avert the spread of malaria in all districts possessed of healthy deltaic or sub-deltaic areas are as follows:—

(1) Prohibition of further embankments. (2) Survey of existing embankments and their water-ways. (3) Survey of river channels and other water-courses. (4) The mapping out of local spill areas and lines of drainage. (5) Improvement of existing water-channels. (6) Examination of the local water-table.

In addition to the measures enumerated above, an attempt must also be made to determine, as accurately as possible, the existing conditions in respect both to malaria and agriculture. Much of the work thus briefly outlined can be undertaken immediately by the existing staffs of engineers, overseers and sub-overseers and the health officers employed by district boards. Such further assistance as may be necessary should be provided by Government under the direction of the respective departments of irrigation, agriculture and public health.

Malaria Survey of Relative Non-Malarious Districts.—In order to map out roughly the relatively healthy deltaic areas in any district and differentiate them from those that are already seriously affected with malaria, a complete malaria survey is not absolutely essential. Valuable information can be obtained without great difficulty by a study of the census reports, the vital statistics and the returns of cases of sickness admitted for treatment at the various dispensaries; and this can be supplemented with estimations of the splenic index in various localities. The census returns show the relative increase of population in thana areas. For our present purpose, areas in which the increase of population has approximated to 10 per cent. in the last decade may be considered "healthy" without further investigation. If the increase has been less than this the birth-rate, death-rate and fever death-rate for the past ten years must be examined. If there is only a small excess of births over deaths and the fever death-rate has shown a tendency to rise, the fever index of the area must be examined, provided there is a local dispensary or dispensaries from which data for this purpose can be obtained. The "fever index," as defined by Sir Ronald Ross, is the ratio of fever cases to the total admissions for all kinds of sickness. The number of new admissions only, both of fever and of total admissions, is taken into consideration for the purpose of preparing the "fever index."

Every district possesses a number of dispensaries. By calculating the fever indices of each of these dispensaries, a rapid estimate can be made of the relative amount of malaria in the various localities they serve. When the figures from each dispensary have been obtained, they may be noted on a map. Maps must be prepared of each district showing (1) the increase of population in the thana areas, (2) the excess of births over deaths, (3) the relative fever death-rates, and (4) the fever indices obtained from the dispensary figures. The information obtained in this way must be further supplemented by obtaining the spleen indices of groups of villages at different points throughout the district. The spleen index is obtained by examining a number of children between the ages of two and ten years, recording the numbers examined and those showing definite enlargement of the spleen on palpation of the abdomen. The ratio of the latter to the total number of children examined is the "*spleen index.*" Besides noting actual cases of splenic enlargement it is usual to record the approximate amount of the enlargement present by measuring it roughly in fingers' breadths below the costal margin. Children might be examined with advantage in villages at various points all along the various lines of communication in a district and also along the banks of the larger streams and the results indicated on a map. When the information detailed above has been obtained and the five sets of maps have been drawn up, it will be possible to correlate the data regarding malaria with that obtained by the survey of embankments, water-courses, spill areas and drainage. An indication will thus be obtained of the areas in which preventive work is most necessary.

Colonial Medical Reports.—No. 186.—Bengal (*contd.*).

The Amelioration of Malaria in the Deltaic Tracts of Bengal.

"*Malaria cannot be successfully combated merely by the distribution of quinine and the supply of mosquito nets.* The Government of a country devastated by the disease must conduct its campaign against the enemy under the generalship of the engineer and the agriculturist, rather than of the sanitary commissioner and the medical scientist. To the latter all credit is due and has in Italy been accorded for the discovery first made in that country of the true cause of malarial fevers[1]. But the expulsion of the pestiferous insect from the land requires the whole machinery of the State and the co-operation of the entire population to be brought into action."—*Sir Edward Buck, K.C.S.I., LL.D.*

The Nature of the Problem.—The earlier chapters of this report have shown that the prevalence of malaria in vast tracts of Western and Central Bengal and smaller areas in both Northern and Eastern Bengal is inextricably bound up with agricultural decline, impoverishment and depopulation. Malaria is a specific infectious disease that, under favourable conditions, can be eradicated by suitable measures aimed at destroying the parasite or the anopheles mosquitoes which transmit it. Physicians know that an acute malarial infection occurring in a person who is favourably situated as regards food, clothing and housing and who can afford to adopt the proper measures, will usually yield to specific treatment very quickly. It is otherwise with the sufferer from chronic malaria, exposed for a long period to semi-starvation and adverse circumstances of all kinds. In his case specific treatment will fail to achieve its purpose, unless it can be combined with generous diet and other measures for improving his general health and relieving his miserable condition. What holds good with individuals holds good also in the case of communities. The amelioration of malaria in the progressive portions of Bengal, where agriculture is flourishing and prosperity increasing, is a relatively simple problem. In these favoured areas much may be hoped from specific anti-malarial sanitation, whether aimed at destroying the parasite with quinine or the anopheles mosquito; and the results of such measures may be expected to be directly proportionate to the expenditure incurred. But neither quinine nor anti-mosquito measures will restore declining agriculture, prevent the impoverishment of the people, or check depopulation, conditions that are characteristic of the decadent, malaria-stricken deltaic tracts in many parts of Bengal. In their case a much more fundamental remedy is required. And unless this remedy can be applied, there is little hope of reclaiming them from their present miserable condition.

Fortunately, a remedy is available; a remedy which promises to relieve the country from economic stress and the Government from financial embarrassment; a remedy that in the past has been adopted with complete success in many deltaic areas once threatened with absolute ruin by agricultural decline, impoverishment and depopulation. And this remedy can be applied in the case of Bengal also with the certainty of equal, if not greater, success. This remedy, moreover, will also eventually provide the resources required for applying the more specific measures of anti-malarial sanitation on a scale adequate for the control and final eradication of malaria. This great remedy referred to is bonification. And the particular method of bonification peculiarly adapted for application to decadent deltaic tracts is irrigation. The whole question of bonification is so important that an entire chapter will be devoted to its discussion; meanwhile, the specific measures of anti-malarial sanitation must be considered in detail. Financial considerations at the moment stand in the way, so that these measures cannot be applied at present on a scale commensurate with the evil they are designed to remedy; nevertheless, they must be given their place in the plan of campaign; and, when economic conditions have been restored by irrigation, it is to these measures that we must eventually look for the final triumph over malaria. Specific anti-malarial sanitation is in the nature of a direct offensive. A direct offensive against a strongly-entrenched enemy is extremely costly and may fail, unless pushed home with the greatest vigour regardless of expense. A skilful general whose immediate resources are limited, instead therefore of courting failure and loss by attempting a frontal attack that must end in failure, strives to keep the enemy at bay while seeking to make their position untenable by a threat to their flank or rear or a bold stroke at their communications. But let the enemy once relax his hold and our good general will drive home his attack all along the line. The same course must be followed in the campaign against malaria. Malaria, the arch-enemy of Bengal, is at present so strongly entrenched in many parts of the country as to defy direct attack on any scale now possible with the meagre resources at our disposal. But malaria can be forced to evacuate its strong position by a flank attack directed upon its main allies, agricultural decline, economic stress and depopulation. This flank attack must take the form of irrigation; and as the methods of irrigation specially adapted for application in the delta tracts of Bengal will also reduce the number of dangerous anopheles mosquitoes very greatly, irrigation will thus strike a simultaneous blow at the transport or line of communications of the malaria parasite. When, as the result of irrigation, agricultural prosperity is restored, the food supply of the people increased, depopulation checked and anophelines simultaneously reduced in number, malaria will suffer its first defeat and gradually begin to retire. Every possible measure of direct attack must then be concentrated upon it with the object of hastening its final discomfiture and driving it completely out of the country.

[1] The discovery of the malaria parasite was made by Laveran in Algeria, and that of the mosquito cycle of the parasite by Ross in India.

Direct Attacks upon Malaria.—Direct attacks can be made against malaria by the following measures:—

(1) Medical treatment aimed at destroying the malarial parasite by the use of quinine.

(2) Anti-mosquito measures specially directed against anopheles mosquitoes and including: (*a*) measures for destroying the adult insect; (*b*) measures for destroying the larvæ (*i*) by the treatment of collections of water with larvicides, (*ii*) by the introduction of small fish and other natural enemies; (*c*) measures for the more effective permanent obliteration of breeding places either (*i*) by draining them, (*ii*) by filling them up; (*d*) measures for the temporary obliteration of the more dangerous small collections of water by "covering" them with an excess of water during the wet season (which is the dangerous period of the year), and thus preventing a large increase of anopheles and spread of malaria that would otherwise occur.

(3) Measures of protection aimed at preventing anopheles from biting human beings by the use of mosquito nets, protective clothing and medicaments which tend to repel adult mosquitoes, and the application to the windows and doors of dwellings of wire-gauze screens.

Combating Malaria by Quinine: the Italian System.—Experience has shown that malaria can be greatly diminished by the widespread use of quinine. In many countries therefore attempts have been made to encourage the use of quinine by making it easily available to the population at a relatively low price. This method has been already used to some extent in India; but it has been much better organized in Italy and Greece. Similar measures have been adopted in Portugal, Austria, Russia, Algeria, Corsica, Bulgaria and Argentina. In most of these countries, the measures adopted by the Government for the popularization of quinine have been greatly assisted by voluntary philanthropic associations, such as the Anti-Malarial League of Greece and the Italian Red Cross Society. Following the earlier example of Bengal, the Italian Government at first aimed at providing a supply of quinine throughout the country and making it available to all classes of the community at a fixed price. They did not, however, make it a State monopoly or interfere in any way with its supply by private wholesale and retail agencies. The price, while fixed sufficiently low to bring it within the reach of most of the population, was not so low as to prevent chemists and druggists deriving a small profit from the sale of the drug. In order to avoid the charge that they were taxing the infirmities of the people to increase revenue, the Italian Government established the principle that all profits accruing from the sale of State quinine should be devoted to anti-malarial work.

The Supply of Quinine—With the exception of Madras, Bengal is the only province where there has been any serious attempt to maintain a stock of quinine sufficient to meet the local demands. Not only has Bengal manufactured her own quinine, but she has bought larger amounts than any other province. It is probable that, provided she can procure cinchona bark for manufacturing purposes, she could allow for a great local expansion in the use of the drug. Last year the sale of quinine through postmasters nearly reached 9,000 lb., and it is possible the total consumption of Government quinine in the province, including that given gratuitously, and that purchased direct by dispensaries, &c., may have been about 17,000 lb. If the Bengal Government had to consider only their own wants they could, with the present manufacturing facilities, meet a demand three times as great as the present one, provided only that cinchona bark can be made available. The bark on the trees at the cinchona plantations is limited, equalling about 150,000 lb. of quinine. But by purchasing the bark Bengal can always manufacture quinine at a cost much below that of the current wholesale price of the drug, viz., under Rs. 10 per lb., as against Rs. 40 to Rs. 50. It would cost, for example, at present rates Rs. 20 to Rs. 25 lakhs to purchase 50,000 lb. of quinine, which could be manufactured if bark is available at a reasonable price for less than Rs. 5 lakhs.

Gratuitous Distribution of Quinine.—Turning to the question of gratuitous distribution of quinine, it must be pointed out that the charitable dispensaries throughout the province provide an agency through which a considerable amount of quinine is every year distributed to the necessitous poor. Reference to the annual reports on the working of hospitals and dispensaries shows that a very large number of patients receive treatment for malaria at these institutions. The total number of admissions for malaria reported in 1923 is 2,135,934.

Fever Cases attending Dispensaries in 1920.—During 1920, the admissions for malaria at 561, out of total of about 700, dispensaries in the province numbered 1,811,739.

Compared with figures obtained in a somewhat similar manner in 1912 and 1917, there appears to have been a great increase of malaria in the last four years. In Eastern Bengal, the fever index is now much higher than in 1912. As the people in Eastern Bengal are generally speaking much better off than those in Western and Central Bengal, they can afford to purchase quinine, hence the larger sales in the former division. The largest number of malaria cases attending individual dispensaries is met with in Central Bengal with an average of 5,505 new admissions per annum; Western Bengal comes second with 4,646; Northern Bengal third with 2,925; and Eastern Bengal last with 1,648.

The Infected Population.—The population infected with malaria is enormous. At the 1911 census, the total population of the province was 45,483,077.

At a rough estimate some thirty millions of these people are infected with malaria and more than ten millions suffer from the disease in an aggravated form. Only a very small proportion of the thirty million cases of malarial infection in the province receive treatment sufficient to afford them relief. A few thousands only get really adequate treatment

in the larger hospitals and dispensaries; under two million receive treatment which is wholly inadequate as far as the supply of quinine is concerned at some hundreds of smaller dispensaries throughout the province; possibly 100,000 or so are attended by qualified medical practitioners; but the vast majority of the sufferers from malaria receive either no medical attention whatsoever or are entirely dependent on such services as can be obtained from untrained village practitioners. A very large number of sufferers from malaria who could afford better treatment rely instead upon one or other of the many quack remedies in the form of fever specifics which are widely advertised in nearly every newspaper as sure cures for malaria. These people usually enjoy the doubtful advantage of purchasing more or less ordinary quinine mixtures under fancy names at a price often ten times their actual value. In recent years the manufacture of spurious quinine tablets bearing a superficial resemblance to those prepared and sold by Government has come into prominence. Bakarganj district has sprung into notoriety in this connection because of the number of manufactories of these bogus quinine tablets which have been discovered there and which have been sending out supplies of the spurious tablets to agents for sale in many other parts of the province.

Value of Quinine and Need of Improving the Supply.—From what has been stated, it will be apparent that the eradication of malaria from Bengal by the use of quinine is at present a proposition that is absolutely impracticable. But it must on no account be forgotten that quinine and the other cinchona derivatives are the most valuable medicinal remedies for malaria that the world has yet seen. A cheap and abundant supply of quinine and other cinchona alkaloids is therefore a necessity. Moreover, the Government of any malarious country that can secure such a supply and ensure that each individual in the population learns both the value of the drug and how best to employ it in case of necessity, confers an inestimable blessing upon its people.

Bengal must therefore face the problem of quinine supply. Much could be said in favour of increasing the manufacture of quinine and cinchona febrifuge. In view of the market price, it would pay to do this even if cinchona bark cannot be imported, for there are possibilities of further extending the plantations because cinchona *succirubra*, which yields the red bark, can be grown at relatively low elevations, some authorities giving 1,500 feet as the lowest limit. The red bark, although not so rich in quinine, yields a large supply of the other cinchona alkaloids which are equally as good as quinine, if not more efficacious in the treatment of malaria. *Cinchona succirubra*, besides growing at a much lower elevation than *Cinchona officinalis* and *Cinchona ledgeriana*, is also said to mature much more rapidly, viz., in five years, as against nine years. It is supposed that very little land is available for planting cinchona at the higher elevations required by *C. officinalis* and *ledgeriana*. It is possible, however, that a considerable area might be found capable of being planted out with *C. succirubra*. Inquiry might show also that the latter would grow in Chittagong hill tracts. Both these possibilities are worth investigating.

Combating Malaria by Anti-Mosquito Measures. The Area to be dealt with.—We have now to consider the possibility of reducing malaria by specific measures of mosquito control. Some idea of the stupendous nature of the task may be gathered from an estimate of the area that would have to be covered by these measures in order to bring about the desired results. The total number of villages in Bengal, as shown by the census of 1911, was 119,334, distributed as follows:—

	Villages	Houses	Population	Average houses	Average population
Western Bengal	24,104	1,858,879	8,467,314	78	350
Central ,,	13,341	1,703,921	9,445,321	125	633
Northern ,,	30,081	1,869,633	10,138,302	47	259
Eastern ,,	43,106	3,199,069	17,432,140	74	404

These figures are only approximate. In the case of the Presidency Division, 1,000,000 has to be deducted from the total population to exclude greater Calcutta and allow for obtaining the average village population.

An approximate estimate of the probable number of villages in which anti-malaria measures would be required may be obtained by using the fever indices of dispensaries in the different divisions. Each dispensary serves a number of villages in its vicinity, and the fever index gives therefore some indication of the amount of malaria in these villages. Excluding areas in which the fever index of 1920 was under 20 per cent., we may say that measures would be required in at least 80,000 villages. Moreover, conditions are very bad indeed in a large proportion of these villages where the fever index is probably over 50 per cent.

We have to consider the possible treatment of practically 70 per cent. of the total villages in the province, over 30 per cent. of which are very severely affected with malaria.

The various types of anti-mosquito work must now be discussed in detail.

Destruction of Adult Mosquitoes.—Mosquitoes may be destroyed by fumigation, or they may be caught in traps or in a hand net and afterwards killed. Fumigation has long been employed in Italy and the United States. The burning of resin is often resorted to in Indian houses in order to drive away mosquitoes. Unfortunately, it does not kill them. Although the destruction of adult stegomyia mosquitoes was of some service in campaigns against yellow fever, Gorgas himself admits that too much reliance was at first placed upon this measure at Panama, and more effective measures aimed at the larvæ did not receive enough attention until experience showed that fumigation by itself was ineffective in checking the disease. The destruction of adult mosquitoes is even less useful

in preventing the spread of malaria. "Hence," says Ross, "the expensive and troublesome process of fumigation is not much employed in malaria prophylaxis." At Panama, mosquito traps and the capture of mosquitoes by hand were used as subsidiary measures in the campaign against malaria. Traps are really of little value except for the capture of mosquitoes for the purposes of a survey or for laboratory work. The capture or destruction of mosquitoes by hand is also of minor importance and in the absence of other measures cannot make an appreciable difference to the spread of malaria.

Ross suggests that the offer of rewards of a penny (an anna) for fifty anopheles may quite possibly lead to a large slaughter by village children. It may also have a contrary effect. On one occasion a planter offered a small monetary reward for the capture of anopheles only to discover after some time that one of the cleverer boys had learned how to breed large numbers in order to make money easily. Bats, birds, lizards, toads, dragon flies and certain other flies are known to catch mosquitoes. Bats have even been encouraged for this purpose in certain parts of California. But although these animals may reduce mosquitoes to some extent, no one can seriously suppose that they could be used as the main instrument for the control of malaria in Bengal.

Measures for Destroying Anopheles Larvæ: Larvicides.—Sir Ronald Ross was the first to propose the control of malaria by the destruction of anopheles larvæ; and the methods suggested by him have been used with marked success at Ismailia, Panama, Havana and many other places. The treatment of collections of water with kerosene or crude petroleum is the simplest method and is now familiar to all. Other preparations may be used also, including emulsions of crude creosote, coal-tar disinfectants and solutions of certain chemicals; but these are generally more expensive than the oil. The cheapest campaign against mosquitoes by oiling was carried out some years since at Port Said, a place where there is little rainfall. The work cost about fivepence (five annas) per head of the population, which is a very low figure, impossible now that prices are so high. Even five annas per head of the population would amount to a very large sum in Bengal. In Calcutta alone, it would mean over three lakhs per annum, and in Bengal it would amount to nearly one and a half crores of rupees per annum. But this latter sum would not be anything like sufficient for the control of the dangerous anopheles mosquitoes in the province.

Destruction of Anopheles Larva by Small Fish, &c.—From time to time the suggestion is made that malaria can be controlled by introducing small fish, ducks or other natural enemies of mosquito larvæ into the collections of water in which these larvæ breed. "No cheaper and better anti-malarial measure," says Ross, "than the extermination of anophelines by natural enemies could be conceived or devised—were such a thing possible." "Unfortunately," he adds, "experience proves that animals and plants survive, even in large numbers, the introduction of their most deadly enemies; they succeed in finding some refuge or other, and a state of commensalism is finally arrived at." He cites Panama as an example where anophelines abounded in spite of the presence of hosts of fish which preyed upon them, and he also states that he "saw a ditch in Calcutta full of small fish and absolutely thick with mosquito larvæ; and have observed fish and larvæ living together in rice fields."

A considerable amount of study has been given to the mosquito-destroying fish of Bengal by Dr. Chaudhuri and others. Observations also have shown that these fishes are widely distributed both in the most malarious and less malarious areas. There are grounds for believing that the supply of fish generally has greatly diminished in many areas in Bengal. The reports of Sir Krishna Gupta and Mr. K. C. De, C.I.E., I.C.S., are both unanimous upon this point; one of the causes being the gradual drying up of the streams and swamps and a general reduction of surface water, and if this is so, the mere introduction of fish without a corresponding increase of water in which they could live would not be likely to prove effective. As it is, almost every collection of water containing anopheles larvæ also contains one or other species of fish that preys upon them. It is only those ignorant of this fact who usually make the suggestion that malaria can be diminished by the introduction of fish.

Irrigation, it may be observed, would undoubtedly favour the increase of fish, and thus help to reduce the number of anopheles. In this connection, the following quotation from a paper read by General Schangti-tong at the Paris International Congress of 1889 is not without interest:—

"I may add that without these gigantic irrigation works, the Chinese could never have carried to such a pitch of perfection one of their most important industries. I speak of pisciculture. Thanks to the abundance of water, the whole of my countrymen, instead of contenting themselves with covering with their fishing boats the seas, rivers and lakes of our country, have devoted themselves to the breeding of fish. The spawn is everywhere carefully collected; far from leaving it to take its chance, the peasant gives this source of wealth a safer shelter in some spot where a perennial supply of water can be assured. The irrigation reservoirs teem with fish. During winter the rice fields are fallow; the water is led into them, and they are instantly full of carp. This industry allows us to make fish a considerable factor in the food of our people. The fish are either eaten fresh, or salted, and dried; they are despatched to all parts of the Empire and sold at a price which is remunerative, though it is exceedingly cheap."

Obviously under the conditions depicted in the above passage, anopheles larvæ can have but little chance to multiply; and it is possible that intensive pisciculture is one of the causes of the remarkable immunity from malaria enjoyed by the deltaic tracts of China.

Colonial Medical Reports.—No. 186.—Bengal *(contd.)*.

Control of Anopheles Breeding Places by Draining or Filling.—Where feasible the control of anopheles breeding places by drainage or their permanent obliteration by filling them up with earth is always advisable. But a consideration of the facts shows that we cannot look to either of these measures for the control of malaria on a large scale in the deltaic areas of Bengal. The vast majority of the infected villages are situated in the deltaic portions of each division where, in the flood season, the level of the rivers is so high that drainage by gravity is out of the question. Drainage by pumping is utterly impossible, not only because of the cost, but owing to the fact that drying the land surface to a degree sufficient to prevent malaria would also prevent the cultivation of rice on which the population depends for its food supply. The village sites in the deltaic areas in which malaria is specially intense are riddled with ditches and borrow-pits of all kinds, and the filling up of the excavations in 80,000 villages is an absolutely impossible task. It is stated that some years ago a rough estimate was made of the cost of filling up borrow-pits, in the municipal areas only, of another province. It is reported that this estimate amounted to two years' total revenue of the province in question.

In recent years certain experiments have been carried out to determine the feasibility of reducing malaria in the more undulating country that exists in the extreme west and the north of the province. In the one case, at Singaran-Toposi, the scheme of work included the periodic flushing of the local river by means of a sluice, the filling up of numerous hollows and depressions and the drainage of many small swamps and other collections of water. By these means a considerable reduction has been effected in the number of anopheles. And on general report there has been a corresponding diminution in the amount of malaria. But the disease has not been nearly eradicated as yet and, although the country dealt with covers considerably over one square mile, it now seems probable that this area is too small to allow the measures a chance of complete success. Similar conclusions have been arrived at in the case of Minglas, where under-draining has been chiefly resorted to and where, within an area covering 500 acres, anopheles breeding places have been almost entirely abolished by this method of draining. Here also the measure of success achieved at present is not sufficient to warrant the assumption that in places such as this, where the infection rate is very high, the total obliteration of anopheles breeding places over an area less than two square miles will serve to eradicate malaria. As the cost of measures of this kind is heavy and increases in proportion with the size of the area to be dealt with, it is clear that at present we cannot count upon eradicating malaria from Bengal by means of drainage and the filling up of hollows.

The Temporary Obliteration of Anopheles Breeding Places by Flooding or "Covering" with Water.—"Covering with water" is Nature's method for controlling malaria in low-lying deltaic swamps. Every year this measure can be seen in action with the happiest results in vast areas in Eastern Bengal. Again and again in past years also the good effect on malaria of high floods in the rivers and copious inundations have been put on record by a host of medical men and other observers. Recently an attempt has been made to apply this method in the case of certain small areas in Bengal that have long been malarious. To this end a small scheme has been carried out at Jangipur and another of a rather different character in a portion of the Burdwan district. The effect of the work at Jangipur is spoken of favourably by the local residents. In 1918, the headmaster of the high school stated that "the health of the town of Jangipur was good when all the surrounding villages as well as all places in this division were subject to the widespread ravages of influenza and malaria. But since the introduction of the anti-malarial scheme, the health of the town has considerably improved." In the same year the superintending engineer in charge of the Banka Valley Scheme reported that:—

"The regulator was used for regulating the depth of water on the land, with the result that the crops, which otherwise would have been destroyed by heavy rain and floods in the Banka, have been saved."

Prevention of Malaria by Protection from the Bites of Mosquitoes.—Protection from mosquito bites can be secured by the use of mosquito nets, screening, fans and repellent oils and medicaments. The educated and well-to-do classes may protect themselves from malaria in this way to a great extent, but the poor will generally refuse the expense incurred. The cost of a good mosquito net is beyond the reach of a vast majority of the people, and the cheap nets now used by some of them soon wear out. The cost of screening a house is very heavy. Punkhas and fans are not practicable for the mass of the population and medicinal culicifuges are of little real value. The dwellings of the poorer classes are everywhere permeable to mosquitoes and to protect such houses would cost as much as rebuilding the whole house. While therefore protection should be urged upon everyone as strongly as possible, this measure cannot be considered as likely to prove immediately effective in reducing the malaria of the community as a whole to any great extent.

In Bengal, although the number of houses is stated to be about one for every five of the population, each house in the rural area consists of a number of isolated huts. The cost of screening these huts, or even providing a mosquito net for each of the inmates, would mount up to a very large sum. To provide the cheapest form of net for the 30,000,000 people in the 83,000 malarious villages would cost at least ten crores of rupees, and at the end of a year most of the nets would be useless. Obviously, therefore, protection from mosquitoes cannot be looked upon as a practicable measure of general malaria control for Bengal at the present time.

Co-operative Anti-malarial Societies.—Although financial considerations at present preclude the extended use of the majority of the specific anti-malarial measures referred to, it by no means

follows that these measures are to be abandoned as useless. On the contrary, they must be adopted wherever possible as far as means will allow. When a general finds that his available supply of ammunition or his heavy artillery is not sufficient to enable him to defeat the enemy by a frontal attack, he neither discards these weapons as useless nor wastes them in fruitless assaults. On the contrary, he employs them when a suitable opportunity offers or husbands them carefully until such time as his resources can be increased sufficiently to enable him to employ them with a certainty of success. Every one of the anti-malarial measures that we have been discussing has its place in the campaign against malaria, and must be applied whenever it can be used to the best advantage. In this connection, attention must be directed to an interesting movement for the formation of co-operative anti-malarial societies that has recently been initiated by Rai Bahadur Dr. Gopal Chandra Chattarji. The aim of this movement is to establish societies for mutual self-help against malaria; and for achieving this purpose many of the various measures referred to are being made use of as far as means will allow. This movement is full of promise. For, quite apart from the immediate results attained against malaria, it offers a valuable means of educating the public and gradually enlisting their help against the common enemy. The movement is at present in its infancy, but it merits every encouragement, for it appears destined to become an important agency for the final eradication of malaria from the country. The fact that societies of this kind are in existence and are making an attempt to improve the localities in which they have been established is a most hopeful sign. And if the originator of the movement lives to see societies of this kind established in every village union throughout the province, he will have achieved his purpose and provided a most potent weapon by which the final control of malaria may be accomplished. Every endeavour should, therefore, be made to further the establishment of co-operative anti-malarial societies throughout the province.

The Effect of Godavari Irrigation on Malaria.—Since the completion of the great irrigation project in the delta of the Godavari, malaria has greatly declined and has now become almost a thing of the past. And the same result has been achieved in the neighbouring delta of the Kistna, where a similar irrigation project has been carried to completion with enormous benefit to the people. Europeans and Indians alike bear witness to the extraordinary immunity from malaria now enjoyed by those residing in these two deltas, in spite of the fact that they live surrounded by rice cultivation, which often extends almost up to the doors of the houses. This was not always a characteristic of the Godavari delta. On the contrary, that area once bore an unenviable reputation owing to the prevalence and severity of malaria. While the irrigation works were still in progress malaria epidemics occurred from time to time and attracted considerable attention. This was especially the case between 1869 and 1873. In 1871, a special medical officer was sent to investigate the outbreaks, which in some quarters had been ascribed to the influence of the irrigation works.

It was not long before the beneficial effects of the irrigation works in reducing malaria began to be apparent.

Sir Arthur Cotton, writing of the Godavari delta in 1878, said: "While the delta has very little fever, the moment you go into the upper tracts you encounter it continually." The improvement in the public health conditions, as regards malaria, has steadily continued. And now, as we have seen, malaria is practically a thing of the past. The *Gazetteer* of the Godavari district contains a statement in this connection, which re-echoes the views of Sir Arthur Cotton. "The fact remains," it says, "that the delta taluks (unlike irrigated areas in some places in this Presidency, the valley of the Tungabhadra, for example) are not greatly subject to malaria, and are, in fact, the part of the district in which it is least prevalent." There is statistical evidence to prove that this is no fancy picture of the conditions relating to malaria. Reference to the annual report of the Dispensaries of the Madras Presidency for 1918 shows that among a total of 449,615 out-patients admitted for treatment at dispensaries in the Godavari delta, only 24,954, or 5·5 per cent., were suffering from malaria. This is in striking contrast to the records of fifty years ago when, as we have seen, malaria was so prevalent in the delta as to be made the subject of a special Resolution of Government.

Reference has been made to the Kistna delta which adjoins that of the Godavari, and like it enjoys the benefits of irrigation. And as in the Godavari delta so also in that of the Kistna, among the blessings bestowed by irrigation, immunity from serious malaria is not the least. At the Simla Malaria Conference of 1909, the Hon. Mr. Weir, I.C.S., drew attention to the fact that the Kistna delta was free of malaria in spite of extensive rice cultivation.

How Bonification Influences Malaria.—Bonification causes a reduction of malaria by the interaction of the following factors:—

(1) Reduction in the numbers of the local anopheline carriers of malaria.

(2) Increase in the number of the local human population.

(3) Increase in the prosperity of the local human population.

At the moment it is unnecessary to discuss the relative importance of these three factors, and it is doubtful if the data available is sufficient to enable us to come to a decision on this point. All that need be stated for our present purpose is that there are grounds for believing that each of the three factors named exerts a favourable influence upon malaria; and that, when these favourable influences are all acting together, the cumulative effect upon malaria is so great as to cause a very marked reduction in the prevalence of the disease

Effect of Reduction of Anopheles on Malaria Prevalence.—It is now universally admitted that a reduction in the number of anopheline carriers of malaria reduces the spread of malarial infection. Ross has pointed out that a complete reduction of anopheles is not essential to the eradication of malaria. "Malaria," he says, "may be completely reduced even by a partial reduction of the anophelines below the necessary limit (which I have roughly estimated to be about 40 different anophelines per head per month) and it may be partially reduced even by a smaller reduction of the insects."

Let us try and get a clearer idea of what this proposition may actually mean in practice. Accepting certain of Ross's mathematical assumptions for this purpose, let us assume that we have to deal with a square mile of malarious country inhabited by 1,000 people, both the human and anopheline population being evenly distributed throughout the area. What would be the effect of permanently reducing the number, or in other words the relative density, of the anopheles mosquitoes? The reduction might conceivably be effected either by obliterating the breeding places or by keeping a permanent staff at work destroying their larvæ, as was done in Panama. Suppose the initial infection rate is very high, so that 999 out of the 1,000 people are infected with malaria. In this case, even very thorough anti-mosquito measures will fail to effect an appreciable reduction in the number of malaria infections.

Now, while it is often an easy matter to reduce anopheles by 25 per cent., and not very difficult to diminish them by 50 per cent., a 75 per cent. reduction is not so easily effected, and to reduce them by 90 per cent. means very careful and thorough work indeed. But even a 90 per cent. reduction of anopheles would not necessarily produce any appreciable effect upon the prevalence of malaria in severely infected areas. The term "appreciable" is used advisably, because existing methods of measuring the malarial infection rates of a community are at present inadequate for clearly demonstrating such small differences in actual infection rates as those between 99·9 and 99 per cent., or even between 99 per cent. and 90 per cent. But there is another reason why even a 90 per cent. reduction of the anopheles breeding within one square mile cannot possibly produce much effect upon malaria, if the initial amount of infection is very great; and this is the effect of migration of anopheles from outside the treated area. In regions of intense malaria, it is not enough merely to abolish all breeding places within a square mile if we wish to protect the people dwelling within that area.

Even if we abolished all anopheles breeding places within our one square mile, migration from without would still supply enough anopheles to keep the rate of infection at over 99 per cent. a quarter of a mile from the boundary and 95 per cent. at the exact centre in the one case, and 91 per cent. at a quarter of a mile from the boundary and 60 per cent. at the centre in the other. In the circumstances stated, therefore, although very thorough and expensive measures may be adopted, they may appear in practice to be absolute failures. And this explains why quite a number of schemes in very malarious parts of India have been looked upon as failures. Now let us glance for a moment at the other side of the picture. Suppose that, instead of 999 or 990 infected persons among the 1,000 in our square mile, only 500 are infected at the beginning, what will be the final result of anti-mosquito measures producing similar reductions, viz., 25 per cent., 50 per cent., 75 per cent. and 90 per cent., in the proportions of anopheline mosquitoes present?

A very substantial fall in the number of malarial infections would follow a relatively small reduction of anopheles mosquitoes, viz., 25 per cent., and the disease would tend to die out completely if the anopheles mosquitoes are reduced by only one-half. When the initial rate of infection among our 1,000 people is lower than 50 per cent., the results would be even more successful and dramatic.

These conceptions are very interesting and also very important, both when considering the application of anti-malarial measures in practice and for understanding the manner in which bonification can bring about a reduction of malaria. In the first case, they enable us to grasp the fact that anti-mosquito measures have their limitation; that in certain places they can be applied with the certainty of producing excellent results, whereas in other circumstances they may appear practically useless; and in the second case they help to explain how irrigation and other measures of bonification that, although primarily aimed at improving agriculture, may also reduce the breeding of anopheles to a considerable extent, will be able to produce a great diminution of malaria.

Some Economic Aspects of Bengal Malaria.—Attention has already been called to the fact that a serious decline of population indicates that a definite change has come over the affected area; and the effects of such a change are not limited to man, but are certain to exert a very marked influence also on both the flora and fauna of the locality, resulting in an increase of certain species and a decrease of others. This view is borne out by the evidence which shows that both the plant and animal life of the areas undergoing depopulation exhibit an increase in certain directions and a decrease in others, and many of these increases and decreases are of special importance to man from an economic standpoint, affecting as they do the question of available food supply very greatly.

The most prominent and best recognized change in relation to fauna is to be seen in the great increase of malaria. If we compare a map of the areas suffering from a decline of population with another showing the relative prevalence of malaria we shall see that there is a rough correspondence between them. Depopulation is, therefore, generally associated with intense malaria. Evidence points to the fact that in the areas in which the human

population is declining malaria has increased very greatly during the last sixty years.

Burdwan, Birbhum, Bankura, Midnapur and Hooghly in Western Bengal were at one time relatively free of malaria and were regarded as sanataria. Similarly Murshidabad and Nadia and a great portion of Jessore in Central Bengal were formerly healthy, and Pabna and Malda in North Bengal were also relatively salubrious. In Eastern Bengal, Tangail in Mymensingh, Manikganj in Dacca, and the northern portions of the Faridpur district, which are now malarious, were formerly relatively free of the disease.

This admitted increase of malaria can only be explained on the assumption that there has been a corresponding increase in the number and distribution of anopheles mosquitoes and malaria parasites in the areas affected. Unfortunately, there are no actual observations on this point. But it must be remembered that the malarial parasite was only discovered in 1880, and the part played by anopheles mosquitoes in its transmission as late as 1898, long after this increase of malaria had taken place. Many healthy localities in which population is increasing usually show scanty signs of malaria. But anopheles mosquitoes of species capable of harbouring the malarial parasite are to be found everywhere and often occur in large numbers in these healthy areas. They do not, however, appear to multiply greatly during the wet season as they do in the unhealthy areas, so that the period of their greatest prevalence does not correspond with that most suitable for the proliferation of malarial parasites. Meanwhile, it may be noted that there are grounds for believing that in the decadent areas anopheles mosquitoes are now far more prevalent during the period of July to October than they used to be, and that his change is associated with a greatly lessened supply of water.

Putting aside for a moment the increase of malaria and the loss of population, it will be seen that the other changes that have been noted as occurring among the fauna and the flora, respectively, of the decadent areas we have been discussing, point to the conclusion that a reduction in the water supply is the origin of the trouble. First of all there is the receding margin of cultivation. This is invariably associated with a lack of water. It is always the drier more elevated lands that go out of cultivation. Then there is the increase of jungle which is largely confined to the relatively high banks of rivers and old village sites, showing that the type of vegetation is one which prefers a dry situation rather than a damp, waterlogged one. The tendency for *Aus* paddy to displace the *Aman* variety is also an indication of diminished moisture. The decreasing supply of fish affords further evidence of a lessened supply of water; and the increase of wild hog and other animals which has followed the increase of jungle points in the same direction. The only fact, therefore, which appears to militate against this view of the situation is the very great increase of malaria which has taken place along with these other changes, and which at first sight appears to preclude the possibility of a diminished supply of water being the cause of the trouble.

But we have only to recall two well-known facts in regard to malaria in order to realize that this difficulty is only an apparent one. Ever since Empedocles flooded the marshes surrounding Selinos in Sicily by a canal constructed for the purpose, and in this way freed the city from malaria, it has been known that swampy low-lying localities cease to be unhealthy when temporarily submerged; and in the old days flooding was often deliberately applied both in Italy and Holland for ameliorating malaria, with most excellent results. But while the flooding of swamps has long been resorted to for checking malaria the partial removal of water from a marshy area has always been regarded as a most dangerous proceeding, calculated to produce a serious intensification of the disease; this belief being justified by the numerous occasions on which the reclamation of swamps has led to severe outbreaks of malaria. Three well-known instances of this kind are the case of the Grande Chartreuse swamp in France, the lowlands of Biensten and de Wonner in Holland and the Whittlesea Mere in England. Such outbreaks were formerly ascribed to miasma given off from the exposed bottom of the marsh. But nowadays the accepted explanation is the great increase of anopheles that takes place when, by partial drying up, a large expanse of water is converted into many small shallow pools.

The Relative Prevalence of Malaria.—The fever indices show that malaria is far more prevalent in Western, Central and Northern Bengal than in Eastern Bengal.

What is the cause of the disparity? Before attempting to answer this question, we must briefly glance at the salient facts relating to the disease. Malaria is caused by a small animal parasite inoculated into the blood of men through the bite of anopheles mosquitoes. These mosquitoes are not naturally infected with malaria, but have first to obtain the parasites by sucking the blood of human beings already infected. Now mosquitoes require water in which to breed; the adult insects cannot exist for many days in a dry atmosphere; and the malaria parasite also requires a certain temperature to enable it to develop in the body of an anopheles mosquito. Before malaria can become prevalent in any locality, or at any given season, therefore, certain conditions must be fulfilled: (*a*) *firstly*, infected human beings must be present; (*b*) *secondly*, suitable collections of surface water for the breeding of anopheles in sufficient numbers must exist; (*c*) *thirdly*, the humidity of the atmosphere must be favourable to the longevity of anopheles, and (*d*) *fourthly*, the temperature of the atmosphere must be high enough to allow the parasite to develop. Although (*a*) and (*b*) often occur at every season of the year, malaria cannot spread unless the conditions (*c*) and (*d*) are satisfied also, which usually occurs only during the wet season

Colonial Medical Reports.—No. 186.—Bengal (*contd.*).

Malaria naturally tends to increase, therefore, during the wet season, and the majority of new infections are as a rule contracted during this period. But owing to the variable incubation period, which may extend to several weeks, and the fact that the sudden onset of colder days and nights tends to determine attacks of fever in those who have become infected and bring out relapses in persons who harbour the parasite, it often happens that the greatest number of actual cases of malarial fever occurs after the end of the rains just at the beginning of the cold season. Thus, it often happens that when cases of malaria are most numerous the conditions actually responsible for the presence of the infection have for the moment passed away with the change of the season. The greatest mortality from malaria is usually met with at a still later period owing to the fact that persons who are chronic cachectics fall victims to malaria in far greater numbers than do those who are suffering from the initial acute attack that usually follows first infection. Malaria, as we have seen, is chiefly propagated during the wet season, as a direct result of the climatic conditions and the great increase of facilities for the breeding of anopheles, which ordinarily occur at this time of the year, owing to the multiplication of collections of surface water. But in certain circumstances an increase of surface water instead of favouring the breeding of anopheles, tends to diminish their number. The nature of collections of water in which anopheles breed, their size, the character of the water and the temperature to which this water is raised by the heat of the sun, all have an important bearing on the multiplication of anopheles. Small collections of water in pools, drains and streams, which possess a large proportion of weedy edge, are most favourable to anopheles larvæ, owing partly to the amount of shelter and food provided and also because the temperature of the water remains relatively low. Large collections of water possess a relatively smaller ratio of dangerous edge to surface and tend to have a higher temperature. Exposure to the sun may render them very unfavourable for mosquito larvæ, while muddy river water appears to be inimical to anopheles larvæ. Now the cultivation of rice is carried on during the rainy season, which coincides with the periods when anopheles mosquitoes ordinarily tend to multiply, and the transmission of malaria infection therefore becomes most active. In the circumstances best suited to the growth of rice in Bengal, it might be thought that the amelioration of malaria was a hopeless undertaking, because it is often assumed that increasing the water must also increase the mosquitoes and the resultant malaria. But, as we have seen, there is a point beyond which an increase of surface water instead of being favourable to anopheles larvæ becomes unfavourable to them, and results in their rapid destruction. This explains the apparent anomaly that those districts which have the highest rainfall and possess the greatest amount of surface water during the cultivating season are the areas where malaria is least prevalent, where agriculture is in a most flourishing condition and where the rural populations have multiplied at a rate far in excess of what might have been thought possible. An ample supply of surface moisture therefore confers a double benefit, improving the yield of the crops and protecting the population from malaria, and these benefits are most conspicuous in the areas liable to inundation with silt-laden river water. Although malaria is chiefly propagated in the wet season, its ravages become most apparent when that season is over. The anopheles have by this time practically finished their season's work, and no attempt to reduce their numbers can therefore have much effect. It follows that when malaria is causing the greatest amount of sickness and mortality the only remedy that can prove immediately useful is the relief of the sufferers by adequate treatment of the disease. If sufficiently intensive to cure the individual and sufficiently extensive to improve the general health of the community the remedial treatment of malaria by quinine may effect a considerable improvement in the conditions of a limited population. But it offers little hope of effecting a permanent amelioration of malaria in a locality, because it leaves conditions relating to the breeding of anopheles (which are those primarily responsible for the existence of the disease) absolutely unaltered. The aim of the sanitarian, therefore, must be to change or control the environment, so that conditions during the season when malaria is actually propagated are made as unsuitable as possible for the breeding of anopheles mosquitoes, while at the same time the human population is benefited directly and indirectly by the measures adopted.

Colonial Medical Reports.—No. 187.—Cairo.

REPORT OF THE MEDICAL OFFICER OF HEALTH, CAIRO CITY, FOR THE YEAR 1922.

VITAL STATISTICS.

(*a*) Population.

The population for Cairo in 1922, as estimated by the Statistical Department, was 777,500, to which, however, should be added 29,590, which represents the population of the area around Helwân that is administered by us for all public health purposes, with the exception of the registration of births and deaths. This makes a total of 807,090, on which all our zymotic charts are based.

(*b*) Births.

The total number of births which occurred in Cairo during 1922 was 41,596, out of which 40,849 were registered as natives and 747 as foreigners. The annual birth-rate was, therefore, 53·5 per thousand of population. This is the highest rate for the last twelve years.

(*c*) Deaths.

The total number of deaths in Cairo during 1922 was 27,350, including 658 deaths of non-residents. Out of this total 26,738 were among natives and 612 foreigners.

(*d*) Infantile Mortality.

The total number of deaths among children under one year during 1922 was 9,954. Out of this total 9,861 were deaths among natives and 93 of foreign parentage.

In addition to these there were 197 deaths of infants coming from outside Cairo and who died in various public institutions.

Infectious Diseases.

The total for all infectious diseases reported during 1922 was 5,135 which includes 395 cases coming from outside Cairo. The total for Cairo proper was 4,740, which is practically the same as last year. Out of this total 2,555, with a mortality of 850, were cases belonging to the eight principal diseases. The remainder include 1,461 cases of influenza, 180 of chicken-pox, 82 of mumps, 4 of Malta fever, 116 of whooping-cough, 21 of tetanus, 3 of encephalitis lethargica. 318 persons bitten by animals underwent anti-rabic treatment.

Regarding the eight principal diseases the total was 529 larger than in 1921 and was due to a large increase of measles.

With the exception of measles the totals of the eight principal diseases are all below the average of the previous eight years.

Smallpox.—The total number of cases notified during the year was 24, which is satisfactory when compared with the previous eight years. There were 10 deaths from this disease, 9 of which were diagnosed after death.

The ages of those who died from this disease ranged from one month to eleven years. All had been vaccinated with the exception of two who were only one month old.

Measles.—The total number of cases recorded in 1922 was 982, being 700 more than in 1921. There were 332 deaths from this disease, of which no less than 322 were diagnosed after death.

Scarlet Fever.—There were 68 cases notified during the year as compared with 66 in 1921, whilst the number of deaths from this disease was 2.

Diphtheria.—The total number of cases recorded in 1922 was 418, as compared with 438 in 1921. The total number of deaths was 146.

Typhoid Fever.—The total number of cases notified during the year was 859, as against 669 in 1921. This compares satisfactorily with the average number recorded during the previous eight years.

Typhus Fever.—The total number of cases recorded during the year was 183, which is the lowest total during the last nine years.

There were 124 deaths.

Relapsing Fever.—There is little to be said about this disease which was quite insignificant this year. Only 13 cases were recorded, with 4 deaths.

Cerebro-spinal Fever.—There were 8 cases of this disease during the year as compared with 14 in 1921 and 28 in 1920. It is, moreover, the lowest total during the last nine years. The number of deaths was 6.

Puerperal Fever.—The total number of deaths from puerperal fever during 1922 was 58, out of which 55 were among natives and 3 among Europeans. There were, however, 27 deaths which occurred within a fortnight of confinement which, if added to the others, would make a total of 85. The causes of these 27 deaths are given as: abortion 3, hæmorrhage 8, difficult labour 2, eclampsia 5, peritonitis 3, nephritis 1, dysentery 1, uræmia 2, enteritis 1, and heart failure 1.

Influenza.—The total number of cases notified during 1922 was 1,461, as against 1,479 in 1921 and 1,587 in 1920. The number of deaths attributed to this disease was 82.

The number of deaths from all respiratory diseases, excluding pulmonary tuberculosis, was 4,621, out of which 1,900 were due to pneumonia, 2,559 to bronchitis, 24 to pleurisy, and 138 to other respiratory diseases.

Of the 1,900 deaths from pneumonia no less than 1,275 were children up to five years of age, 159 from over five to fifteen, 170 from over fifteen to thirty-five and 296 over thirty-five.

Encephalitis lethargica.—There were 3 cases notified during the year, all of whom died.

Case-mortality of Infectious Disease.—For the benefit of readers of this report, who are unfamiliar with the conditions under which work is carried on in this country it would perhaps be as well to say a few words with regard to the figures shown for case mortality, which must appear to be enormous.

The fact is that the notification of infectious disease is very defective. Many doctors are lax in the performance of this legal obligation. In a very great number of cases no doctor is called in during life, the disease being diagnosed only after death. Cases of recovery from the disease unattended by a doctor never come to our knowledge. The degree to which the case-mortality figures are affected by this state of affairs varies according to the nature of the disease. For example, the case-mortality figure for small-pox is probably nearly correct, but that for measles is very much higher than the fact, the reason being that small-pox makes its existence so evident that it cannot well be concealed and notification of cases which eventually recover takes place to a far greater extent than occurs with regard to other diseases, such as measles.

Again, as all foreigners call in a doctor to attend their sick, those diseases to which foreigners appear to be more susceptible than natives—such as scarlet fever—are likely to be better notified. The case-mortality figures for such diseases will therefore be less widely in error.

Colonial Medical Reports.—No. 188.—Madras.

ANNUAL REPORT OF THE HEALTH OFFICER OF THE CITY OF MADRAS FOR THE YEAR 1924.

THERE were 21,960 deaths registered during the year, representing a crude death-rate of 41·7, as against 37·8 in the previous year, and the average for the preceding ten years of 42·8. Respiratory causes were the prime contributory causes of the general death-rate, being followed by dysentery, diarrhœa and fever, &c.

Owing to the absence of any epidemic disease in 1924, one would have expected a fall in death returns. Whereas the principal causes of death may be classified under three principal groups, viz., "Infectious diseases," which account for nearly 42 per cent. of deaths, "other respiratory diseases" and "all other causes." Amongst the diseases classified under the first group are diarrhœa and dysentery, tuberculosis, pneumonia, malaria and other fevers, in the descending order of frequency, causes mostly preventable.

"Other respiratory diseases" is shown as a separate group, as they obtain a conspicuous place in our returns, even after excluding tubercle of the lung, &c., pneumonia. Especially it would be somewhat perplexing that so many should die from lung troubles under equable climatic conditions such as Madras uniformly has. It would generally be presumed that respiratory diseases are a special feature of cold countries. While it may be so to a small extent, the exciting causes provoking lung affection have very largely to be sought for in the fact that people live in over-crowded, dark houses where there are the least possible chances for movements of air in and out—ventilation—and where, consequently, they have to breathe an atmosphere continually laden with dust and vitiated by human exhalations and those from the unpaved yards, drains, cesspools, &c.—not to speak of domesticated animals.

The total number of deaths during 1924 exceeds that in 1923 by 2,027, of which nearly 45 per cent. is accounted for by an increase in mortality amongst infants and children under five years and 24 per cent. amongst persons over fifty years of age—age-periods which are more vulnerable to unhygienic and insanitary environments.

The problem lying immediately in front is the urgency for a continued and intensive policy of health reform, whose chief objects are (1) to prevent or remove the circumstances which originate, maintain and propagate disease and bring about death, and (2) to conserve and strengthen the normal physique of the people as a whole, in order that life may be happier and more productive. These objects cannot be achieved by "piecemeal effort, spasmodic endeavour or convulsive action inspired by fear or emergency." They can be of some avail in dealing with outbreaks of small-pox or cholera, but are wholly inadequate if the aim is to eradicate or uproot such plagues from amongst us. The lull is only apparent, the specific infective material is lurking here, there and everywhere, and, given opportunities such as lowered vitality, unfavourable weather conditions and overcrowding, as in fairs, festivals, &c. they flare up into epidemics. So that from year end to year end we are in a continued state of anxious expectancy and preparedness to tackle one infection or another. Preventive measures such as notification, prompt isolation, disinfection, vaccination, surveillance of contacts are sufficiently effective in controlling these diseases, but can have very little influence upon diseases like enteric, diarrhœa, dysentery, influenza and such others as are enumerated to be the more commoner amongst human ailments at present.

The problem of prevention of influenza is in the avoidance of relatively massive or "droplet" infection and can only be practised by individual as well as by communal action; and the public authority, in addition to advising and guiding public opinion and effort on sound lines, should have power to close places of public gathering and entertainments where the continued crowding together of large numbers in close quarters conduces to cross-infections and secondary infections.

The problem of enteric—including in a large measure fevers of indefinite origin—can only be solved in proportion to the wholesomeness of sanitary environment, which can be defined as "the ordinary supply of what is necessary for civilized social life," as concerned, chiefly, with water-supply, sewage, housing, removal of refuse and filth and control of food supplies.

Sir John Simon wrote in 1869:—"Among the circumstances which we find associated in outbreaks of typhoid fever, there is none of more frequent occurrence, none which we are more entitled to consider directly causative of the disease than the consumption of polluted water. It has been one of our most familiar experiences that excremental fouling of wells is, in this respect, amongst the worst dangers which threaten the health of a community."

"Many of the public improvements," wrote Sir George Buchanan as far back as 1866, "have coincided with reduction of typhoid. Though not with absolute constancy, drying of the soil of a town and reduction in the crowding of houses have been followed by reduction of fever. Much more important appears to be the substitution of an ample supply of good water for a scanty and impure supply; other things being equal, the towns in which the substitution has been completed have made most improvement."

Improvement in the reduction of cholera epidemic, diarrhœa and dysentery as well as typhoid can only occur *pari passu* with the improvement of water-supply. Experience in the more advanced countries has shown that the steady decline in enteric is attributable to improved water supplies, sanitation and protection of food. Water, milk or food in general are not necessarily or inherently connected with the ætiology of typhoid fever and "enteric" diseases. They become concerned as they are polluted at the source, or in transit before consumption.

The outlook of tuberculosis is equally limited and would remain invulnerable with the ordinary measure of prophylaxis, which sanitarians usually resort to. There is no single or isolated method of treatment as a panacea. Strict isolation is not only impossible, but ineffective. Disinfection begets a sense of security which is nebulous. Improved environment is not enough; nutrition and open-air life by themselves will not do. The dispensary, sanatorium and hospital in each by itself is inadequate. It is a national evil. It augurs to be one of the most formidable problems of national health; and it calls for a national organization of a specialized tuberculosis service. The preventive attack needs to be comprehensive and should include sanitation, lighting, ventilation, housing and removal of overcrowding, nutrition of the people, the abolition of tuberculous milk, domestic cleanliness and avoidance of spitting in public places and thoroughfares. In short, the vulnerable points in these infections are to be sought for as much in the sanitary environment as in the individual himself.

Causes of Mortality—Infectious Diseases.

Malaria.—Malaria caused 4·4 per cent. of the total deaths, as against 3·9 per cent. for 1923; 971 persons died of this cause, as against 783 in 1923. The disease seems to be on the increase since 1920, especially the northern part of the city suffered more. The question of reorganizing special measures to combat the disease is under consideration.

Enteric Fever.—There were 65 deaths from enteric fever during the year.

The figures can by no means be taken as accurate, since they represent almost wholly those cases notified by the public hospitals; nor do these figures give any indication as to the exact incidence of the disease. Under sub-section (1) of section 330 of the Madras City Municipal Act IV of 1919 it is obligatory on the part of the medical practitioners, hakims and vaidyans in the city to report to the health authorities the occurrence of such cases within their knowledge, but these cases are reported by a few of the medical practitioners and by hospitals only after the death of the patient. The cases that do recover go unreported. Thus a correct record of the incidence of this disease is not available. A good number of fatal cases of fever were probably cases of enteric fever. All the fevers which are not definitely diagnosed are usually reported under the convenient term "pyrexia" and real nature of the disease is unknown. The medical practitioner cannot be entirely blamed for his failure to report cases of enteric fever. Because what usually happens is this: when a person falls ill, the most usual thing obtaining with the masses is to try "home remedies" on him for about a week; when these fail, as they usually do if the disease is enteric, recourse is had to treatment by a vaidyan or a hakim for about another week. Under this treatment the patient either gets worse or rarely recovers. If he dies the case is reported as fever, and if it is worse a medical practitioner is perhaps called in at a late stage. The medical practitioner has then to go about making a correct diagnosis from the clinical symptoms or by bacteriological examination, which means further delay. If, unfortunately, the patient dies immediately, or in the meantime, the case is one of "fever" of unknown origin; and often in reply to our inquiries we are told that the particular medical practitioner was called in just before death, and that no diagnosis was possible. If the case is really one of enteric it will be seen what a great deal of mischief must have been done already in the way of spreading infection through the discharges of the patient, flies and human "carriers," and greater still will be the mischief when one remembers that the stools of the patient are emptied into the house drain or latrine common to a number of tenements, who, moreover, are not in the least anxious or alarmed at the knowledge of the occurrence of such a dangerous infective disease at such close quarters. Thus cases are rarely notified, or are notified so late that prophylactic measures employed can have but little effect inasmuch as a great deal of mischief has been done. Above all, a large number of cases of enteric in this country, unlike in other parts of the world, are treated at the homes, which are mostly overcrowded and ill-ventilated, and obtain little or no bedside care, so much so that by all means facilities for the spread of disease are very prolific

The prevention or eradication of enteric in a word depends entirely or wholly upon a pure water supply abolition of the present dry method of collection and disposal of human excreta, viz., hand removal, trenching or depositing at random, total wiping away of the cesspool and protection of milk and other articles of food.

Colonial Medical Reports.—No. 188.—Madras (*contd.*).

The city water supply, in spite of all that has been done to protect and purify it, is far from wholesome and has been responsible in a measure for high mortality returns and incidence of water-borne diseases, not excluding fevers, diarrhœa and dysentery. The adoption of water-carriage system of excrement disposal seems to be the chief means to improve the state of health of our city as has been the experience of many of the western countries.

In addition to the injurious effect of dust and effluvia the "fly" problem has to be tackled. Flies are known to convey contagion on their hairy legs from infected excreta to some articles of food, in addition to infected dust.

Pending the consummation of such general sanitary reforms devoutly wished for, this disease has to be tackled from the standpoint of the sufferer and his immediate contacts, as is circumscribed by human element. It then is transmissible, (*a*) by those actually suffering, (*b*) by those with the "ambullatory" type, (*c*) by contacts and convalescents, whose fæces and urine contain bacilli and who, as such, act as "carriers" of this disease. The former class constitute a potent danger for the community at large, especially so if they happen to be cooks or servant boys or maids, for without having actually suffered from the disease, they harbour these bacilli and pass them in large numbers with their dejecta. In the present state of knowledge it has been found impossible, even in the most advanced west, to free from the bacilli such persons who are under no sort of control, and measures suggested to minimize the risk of infection are not likely to be carried out in actual practice.

In the case of the patient, all preventable measures are to be taken at the bedside, such as his isolation, disinfection of all his dejecta, the cleaning of the hands of the attendants. The contacts are inoculated with anti-typhoid vaccine wherever possible and kept under observation, in order to save others who, as contacts, may get ill.

Kala-azar.—Fifty deaths were registered from this cause, the corresponding number in 1923 being 52. It is understood that this dangerous infectious fever is somewhat on the increase. It were better if sufferers quickly took to the specific treatment by consulting their physicians promptly. By this means not only are the sufferers cured of what otherwise would prove a fatal illness, but also they are rendered non-infective, and thus safe to the community.

Cholera.—Sporadic cases of cholera are reported from time to time almost during the whole of the year. The rise in the number of cases reported generally depends on various factors, such as (*a*) climate, as it might affect articles of food stored, cooked and uncooked, (*b*) the rise and fall of subsoil water, as it might affect wells, and (*c*) very largely upon the chances of importation of cases into the city. It is observed that invariably few cases begin to be reported early in September and on the heels of the Periapalayam festival and of other festivals in the adjoining district where cases are known to occur. It has also been noticed that soon after the very early and somewhat small showers of the north-east monsoon, the number of cases reported go up. Moreover, during the months of August and September, which are auspicious ones for Hindus, a number of people perform religious vows on account of which they cook an article of food from ragi called "Koolu." This is kept for over two days until the thing gets sour and is then distributed to several people who in turn drink of it during the course of the day or next day. Again, during the last two or three months a special class of fish which is long and thin in appearance, called in Tamil *ola valai*, or colloquially sword-fish, is largely partaken of with rice and more often kept overnight to serve for the following early breakfast. This variety of fish is found in abundance in the near approaches of the sea, especially soon after the first rains of the north-east monsoon, and shoals of which are sold in almost all markets dead cheap; and universally consumed by the poorer classes. There is a noticeable correlation between the incoming of this fish and the reports of outbreaks of cholera cases as cause and effect. In almost all the houses from which cases were reported, it was found that the person or persons partaking of that food were attacked. There were, for instance, five cases in a house in Perambur division in a tenemented house and four cases in one family in Mylapore, 28th division. Food containing this variety of fish, possibly stale, was in all those cases held to have been the exciting cause of the disease. So much so that the city has rarely ever been reported to have been wholly free from sporadic cases of cholera during any year. For the year under review up to November 1 there were reported 75 attacks and 45 deaths.

Small-pox.—Like cholera, small-pox is endemic in the city, one or more cases occurring in a sporadic form throughout the whole year. In short, the health department is required to be continually on the lookout and in readiness to tackle one or other or both of the diseases year after year. There were 665 cases reported during the year, of which 197, or 29·6 per cent., proved fatal, as against 481 attacks and 151, or 31·3 per cent., of deaths during the previous year. As in cholera, the spread of small-pox is certainly or more quickly arrested by prompt isolation. This is but appropriate, as it is, perhaps, the one and the only one amongst eruptive fevers which has the most potent infective material. "There is no contagion so sure and so strong as small-pox; none that strikes at so great a distance."

"In denying any connection between insanitation and small-pox, exception must be made in respect of overcrowding. Like other infectious diseases, small-pox is most easily spread when the most frequent opportunities exist for personal intercourse. It is, therefore, most often met with and greater in amount in busy centres of population than in

scattered rural districts," says Sir Arthur Newsholme. This statement can nowhere be better demonstrated than in this city. During the epidemic of small-pox in 1922, the first three divisions were badly affected. People living in these divisions are of the poorest classes, almost the whole of them living on wages which they earn by daily labour. Each family lives in a single room in a house containing five or more tenements. Many others house themselves in huts and billets covered around and on top by palmyra or other leaves. Apart from their being exposed to the vicissitudes of weather, the sanitary environment under which they live is entirely unwholesome. There is an overcrowding in such tenements that creates and harbours filth which actually breeds disease. More cases are time and again reported from the overcrowded parts within the heart of the city than from its outskirts, although socially and economically the people of the former areas are more favourably situated than those of the latter. The reason is obvious. People living at the outskirts, whatever their poverty and kind of housing, &c., have assuredly a freer and more abundant air and open space and less overcrowding, whether they like them or not.

For some months past it has become more and more apparent that amongst the cases which are returned as small-pox there is a fair proportion which are not by any means typical of small-pox as usually met with in this country—even when modified by vaccination. Nor are these cases akin to chicken-pox either. The initial symptoms are not quite so mild as in chicken-pox and not so severe as in small-pox. The fever rarely goes above 102° F. and the rash appears simultaneously with the fever or a few hours after as small spots and in regular sequence (successive crops), usually first on the forehead, then on abdomen and back, chest and extremities. The relative proportion of the number of pocks is far greater in the abdomen and back than in other parts of the body, and there are particularly few on the hands and feet. The vesicles are usually dome-shaped containing a scanty amount of dull, white, clear watery fluid (not clear as in chicken-pox), looking as if the skin were bespattered with tiny acne spots. There is no primary umbilation and the individual pox grows to a size somewhat smaller than is ordinarily known in cases of small-pox or chicken-pox. The further evolution is rapid, the pustular stage supervening within 24 to 36 hours after the appearance of the vesicle and each pustule containing but a tiny whitish pus-like bead, and pricked it does not collapse so readily as in chicken-pox. The initial fever does not disappear on the appearance of the rash, but continues between 100 and 102 degrees for two or three days, at the end of which all the symptoms subside so completely that the patients feel quite well and anxious to move about. There is no secondary rise of temperature coincident with pustulation as in small-pox. In fact, after the third or fourth day from the commencement, the patients complain of no other inconvenience than the irritation due to the presence of the eruption. The eruption in point of its extent, development and distribution is quite unlike that in chicken-pox. The pox begin to dry up from the eighth or ninth day until the fourteenth or fifteenth day from the date of onset of disease. There is no pitting and the scars disappear in a week or two. The majority of cases have been amongst young adults, especially those belonging to the west coast. Three children between the ages of 7 and 10 were found to exhibit these signs at hospital and all the cases bore very good marks of successful vaccination. It is reported that the protective power of vaccination does not appear to be of so definite a character as in ordinary small-pox, although vaccination reinforced by recent vaccination is stated to confer protection.

The signs and symptoms described above are closely akin to a description of a similar disease investigated in parts of South America and the West Indies and called by the term "Alastrim." These circumstances have been reported to the Director, King Institute, Guindy, who has kindly undertaken an investigation in this matter.

Measles.—There were 32 deaths during the year.

Influenza.—The total number of deaths registered under influenza was 14 for the year, against 19 in 1923.

Plague.—No case of plague, either imported or indigenous was reported during the year.

Diarrhœa and Dysentery.—3,700 deaths were recorded during the year from these causes. The largest number of deaths were recorded in January, August and October.

Diarrhœal diseases are almost entirely waterborne and a fall in their incidence can only follow in proportion to the extent of the improvements that can be effected in the purification of our water supply and the control that can be exercised on the sale of articles of food and drink.

General Respiratory Diseases, excluding Tubercle of the Lung.—4,130 deaths were registered from this cause. The number of deaths from these causes has been the highest since 1919.

Tuberculosis, including Tubercle of the Lung.—1,468 deaths were registered under this head, or 200 deaths more than in the previous year.

Relapsing Fever.—There were 5 cases of relapsing fever reported during the year, and all of them were imported.

Control over Waters.—Ever since the reduction of the establishment under "malaria" mosquitoes have not ceased to flourish nor has malaria gone down. Madras City still continues to be an endemic area for malaria, and everyone who has the welfare of the city at heart should feel anxious to rid the city of this "scourge." Malaria is perhaps the only disease whose inroads into the human system are so insiduous and often unfathomed that it sooner or later saps the vitality of human beings and kills them far too prematurely. Suitable provision must be made for a special staff to carry out remedial and preventive measures, such as cleaning

of tanks and wells and such other breeding grounds, special attention being paid to the eradication of water hyacinth, petrolizing tanks, ponds, marshes and wells and reclaiming them wherever possible, introduction of larvicidal fish, drainage of water-logged lowlands; in short, eradicating by all possible means every breeding ground of mosquitoes of whatever denomination—malaria or non-malaria —for as human blood-suckers they are as great a danger as any other public nuisance; and not until this is done can the Corporation think of rooting out malaria from the city, for malaria has been demanding a great toll of citizens' valuable lives.

The Cooum and the Buckingham Canal, the two "meandering cesspools," still continue to be offensive, although the Government (P.W.D.) has been petitioned several times for their proper maintenance. Probably it is neither practicable nor economical to carry out any spasmodic efforts at cleaning these waterways short of dredging them and this cannot be done until a good flush and flow from the upper reaches can be ensured. But in any case, until some practical solution of rendering these neat and clean is carried out the city must suffer from its odours and the insect pests that breed in them.

A Practical Scheme for Securing the Supply and Distribution of Clean, Unadulterated Milk in a Large City.

(1) A pure, unadulterated, and abundant milk supply, readily procurable by all classes, is one of the essential factors in any sound scheme of nutrition. Adequate nutrition ensures proper growth and development of the body, and increases its resistance to disease. No single article of diet other than milk combines so well the necessary constituents of food required, especially by young and growing children. To these cow's milk is next best to mother's milk. And yet milk is perhaps the one article of food the proper use of which is almost entirely unknown to large sections of the population. Milk again is an article that is easily adulterated; whether this be by mere addition of water, partial extraction of fat, addition of preservatives, contamination by dirt and filth, milk retains its natural "milky-white" appearance, and man is easily deluded into false security. The average daily milk consumption of the population in general is not more than an ounce per head. Unlike in the west, large sections of people partake of curd buttermilk prepared from milk, which, being generally diluted, is of little nutritional value, although it unquestionably is an invaluable adjunct for promoting digestive functions and for supplying those valuable accessory food factors—vitamins.

(2) It is difficult to assess the exact causes contributing to the neglect of this valuable dietary. Ignorance as to its food value is undoubtedly the first; secondly, there exists the misconception that milk causes indigestion; thirdly, there is a traditional belief, at least in South India, that in children milk causes katti—enlargement of liver and spleen —which really is an independent condition called hypertrophic cirrhosis of liver. Possibly milk is a channel of infection due to its reaching the consumer in grossly adulterated and unwholesome condition. Town populations seldom use milk at its best; too often encounter it at its worst, when filthy, stale or sour. Almost all the milk distributed for consumption is produced under extremely insanitary conditions and is liable in course of production, handling, and distribution to gross contamination by dirt. It is often infected with disease-causing germs such as tubercle or typhoid. Such is the milk consumed by young infants, delicate children and invalids. Amongst the infectious diseases of man communicated by animals, tuberculosis is by far the most important, and although there is little or no direct evidence in this country, experience and investigation in other countries have established that bovine tuberculosis is conveyed to the human subject through milk. Milk, even after sterilization, is liable to contamination for want of efficient storage. The milk problem is a formidable one bearing directly on the health of the community. Briefly stated the key to future improvement depends upon:

(1) Encouraging production of larger quantities of milk and increased consumption, especially in the young.

(2) Improving the quality of milk, as regards freshness, nutritive value, unadulteration and freedom from danger to health.

(3) Before suggesting remedial measures for improvement, it is necessary to review existing conditions regarding milk, its production and supply. Throughout the length and breadth of this country systematized dairying as a profession or trade does not exist. It is almost wholly in the hands of petty dealers or householders who keep a few animals, just enough for a bare living. The father attends to the milking of animals, their upkeep and sale of milk; the womenfolk assist in getting the curd and butter (for ghee) and hawk these about. The average milkman is heavily encumbered, and is continually in the clutches of the moneylender.

(4) Success in dairying depends chiefly upon the proper selection of the dairy herd. Cows whose milk-yield is low, whose dry period is long and which are irregular in calving, cannot but increase the cost of production of milk. The best animals in South India are bad enough, there being three breeds at least, viz., Kangayam, Ongole and "Cross-breeds." The Kangayams are the worst, and the "Cross-breeds" the best milkers; the Ongoles are fairly steady, yielding an average of two measures or nearly eight pounds daily. The quality of milk, especially its fat-content, varies in accordance with the stock and available food. In Madras and the South the chief food is paddy-straw and gingelly-cake; in the Northern Circars and almost the whole of North India cotton-seed, cholam, or wheat-stalks. Milk of the Northern animals is comparatively rich in quality.

(5) From a business point of view the maintenance of buffaloes purely for milk would be a

step in the right direction. Popular sentiment, however, in this Presidency is against buffalo milk as unsuited to children. Its use is restricted to the extraction of fat directly, or after conversion into curd or buttermilk. In other provinces its value is greater, since it is used in large quantities for preparation of the sweets so largely consumed by the people. Another important fact hindering successful dairying is that milk cannot be produced at long distances from centres of population. In addition to the want of railway and other facilities for quick transport, milk undergoes rapid changes in this country, and becomes sour within about twelve hours after production, especially amidst the unhygienic conditions generally prevailing. It becomes further contaminated in the home for want of proper care and protection.

(6) From these circumstances, combined with the facts that there are no suitable penalties for adulteration, and that the public demand a large measure for a small sum, springs the whole system of adulteration and fraud. The adulteration generally consists of adding water or buffalo's milk after removing fat and diluting suitably. Undoubtedly, the dairyman could not live but for the adulteration he practises. The problem of adequate milk supply has therefore to be considered from the aspect not only of public health, but also of economics. If milk is to be supplied unadulterated, then to make production economic, (*a*) the price must be increased, or (*b*) better business methods introduced and good milking-stock bred. Perhaps under existing economic conditions comparatively few people can pay an increased price. The public need to learn that, in comparison with other fat and protein-yielding foods commonly employed by poorer classes, pure, wholesome milk has always been relatively cheap; more especially should people learn that milk plays an important rôle in dietetics as a "protective" food, in supplying the food-accessory substances (vitamins) which are required for growth of the body and for its preservation from certain affections and which are liable to be wanting in other articles of diet. With better business methods pure milk can be supplied at current prices.

(7) Milk for human consumption should be pure, clean, wholesome and unadulterated, drawn from healthy cows under sanitary conditions; drawn by a clean method of milking into clean vessels; cooled at the farm; protected during transit, delivery and in the home, from all forms of infection and contamination. Control can be exercised (*a*) by the *sanitary authority* effectively administering local powers of control over adulteration, uncleanliness, infection; (*b*) by the *dairy trade* working on economic, clean and scientific business lines; (*c*) by the *consumer* demanding pure milk, he himself protecting it from contamination; (*d*) by *commmunal enterprise* producing or demanding 'certified" milk.

(8) This fourfold control cannot obviously be practised by individuals. The question is one of national importance, and calls for a national policy; for "malnutrition is wider in incidence and more devastating in issue to a community than food-borne disease." An enlightened milk policy should aim at the following: (*a*) To economize cost of production in order to (i) increase its consumption, (ii) bring supplies within the reach of the poorest families; (*b*) to improve and control hygienic production and quality; (*c*) to educate the public with regard to the nutritive properties of milk; (*d*) to increase supply in order to meet the extended consumption which should follow improved quality and public enlightenment; and (*e*) to prevent exploitation of the producer by combination or trust.

(9) Dairy farming should be developed as one of the most important, productive, stable and economic branches of agriculture. The broad lines of hygienic milk reform are: (*a*) Clean, effective dairying at the farm and the retail dairy—the supervision and control of milk production at the source; (*b*) improved methods of distribution to avoid deterioration and loss through souring, &c.; (*c*) stringent legislation and effectual administration of Milk and Dairy Orders, regulation of milk under Food and Drugs Act, control of *condemned* milks; (*d*) proper care and protection in the home.

(10) Unfortunately in Indian towns there are material differences in methods of dairying and supply. While in Northern India milk and milk-products produced in the byre are conveyed to milk and curd shops (dood and dahi khanas) and there retailed to consumers, in Southern India milk is either produced at the consumer's house in his presence or conveyed by the producer or his agent, when it is invariably adulterated. In a country where every particle of surplus milk may be converted into curd or buttermilk, dairying ought to be easy and profitable. Curd, buttermilk and ghee—all milk products—are daily articles of Indian dietary, especially vegetarian dietary.

(11) For reasons already enumerated, it is somewhat difficult to propound a scheme for universal adoption in Indian towns. The only means of meeting the situation is to organize dairying as a business concern. Dairy farming, coupled with breeding of stock, would improve the milking capacity of cows and make the whole concern profitable. A dairy farm should preferably be located on the outskirts of the town for which the supply is intended. There should be sufficient pasture land available for immediate grazing and future extensions. The dairyman, who in his own interest should live on the premises, should not only produce the milk at the farm under sanitary conditions, but should also provide facilities for transporting it to the several shops where it is sold by retail or to registered customers. The milk immediately after it is drawn from cows should be mixed, screened, put in suitable covered cans, locked and sealed, and placed in cold storage awaiting dispatch. For smaller consumers who contract for a regular supply daily, the milk should be canned or bottled at the dairy, and delivered at their houses.

Colonial Medical Reports.—No. 188.—Madras (*contd.*).

Cans or bottles should be in duplicate; while one with milk is delivered, the empty is returned to the farm for cleansing and use for the next supply. These cans should have good locks and duplicate keys, one with the dairyman or manager, and the other with the householder. All utensils in the dairy or shop should be thoroughly sterilized in boiling water or steam before being brought into use. The utmost attention should be paid to minutest details to achieve two ends; (1) to prevent contamination, the chief sources of which are the udder and teats of the cow, the hands of the milker, the atmosphere and utensils and vessels in which the milk is collected and transported; (2) to prevent fraud and adulteration at all points from production to delivery to consumers. Retail shops should be opened at public and private markets and at other places reasonably approachable. Fresh milk should be available both in the mornings and evenings. All surplus milk should be promptly curdled or defatted, and the resultant produce sold at the shops or to professional hawkers. The dairy should have a creamery, and the butter manufactured sold as such or as ghee. There should be one or more motor or horse-drawn vehicles for quick transport to shops and for house-to-house delivery morning and evening.

(12) Effective pasteurization for sterilizing milk before delivery needs great care and technical skill; as practised even in England, it is considered unsatisfactory and unreliable as a means of protection to the consumer. The range of temperature should be such as not only to ensure destruction of pathogenic bacteria within the limit of time of exposure, but to preserve taste, physical properties and its vitamine-content. Moreover, fresh milk is more resistant to growth of bacteria than that which becomes infected after pasteurization. Milk produced under clean conditions, properly cooled and despatched in clean, airtight vessels will retain the property of freshness long enough for all ordinary purposes of transport, delivery and household storage. "Freshness in milk is in common experience determined less by age than by the care and cleanliness with which it is produced and subsequently handled."

The average Indian will not purchase anything but raw milk, which he generally boils before use.

(13) Dairying means heavy money outlay, and want of money is a great obstacle to public health progress. Dairying should be started on Joint Stock Company or an Co-operative lines. Where an enterprising person comes forward to start a dairy, the State should encourage him and afford facilities by securing enough land free or at a nominal rent—at least until the business is established.

To be more paying and to keep down average cost of pure milk, it is desirable to have a few she-buffaloes (about 20 per cent.) of good stock, yielding large quantities of rich milk, as the products thereof, viz., butter, ghee and curd, find a ready sale and bring in quick returns. Within a few years stock may be bred on the farm. There should be two or more breeding bulls of high pedigree, imported if necessary, for cross-breeding. Herd and pedigree registers should be maintained and unprofitable cows weeded out. Bulky, concentrated food should be prepared previously. Milking herd should be stall-fed and allowed to graze on green pastures. Dry herd and young stock should be put out to graze freely, as this would tend to economy in upkeep. They should be properly housed in airy, well-ventilated, paved sheds, cared for and supervised. The creamery and store-room should be strictly fly-proof. All dung, manure, &c., should be regularly collected, stored away from the sheds, then sold or used as manure. He-calves should be fattened and sold for profit; cow-calves added to the herd.

(14) The number of such dairies required for a town depends upon the population and demand. At the same time it would be impracticable to wipe out at once the petty trader. The existing unsatisfactory, unhygienic conditions should be removed by rigorous administration of statutory legislation governing dairies, cow-sheds, milkshops, &c. These people should be educated to understand that a dairy where animals are under ideal sanitary conditions, and where milk is produced under scrupulously clean conditions, will, in the long run, be more paying than those located in congested localities where animals are overcrowded in filthy yards and where cleanliness is impossible; animals in the former will be healthier and longer-lived, and they will yield comparatively more milk with better keeping qualities than in the latter, where on account of sickness and probable death of animals, dairying would be unprofitable and impossible. The local authority could also assist such people by constructing and letting out on normal rents sanitary byres to accommodate a hundred animals each in different parts of the town.

(15) Effective legislation should have precedence over everything else. To increase consumption milk should be attractive, appetizing, with good keeping qualities and of recognized economic value. These problems involve the passing of Dairy Orders and Regulations and their effective application.

Legislation to control and regulate milk supply should be all-comprehensive and embrace the following:—(1) Registration by the sanitary authority of all persons carrying on the trade of cow-keepers, dairymen, purveyors of milk and their licensing. (2) Regulations prescribing paving of floors, lighting and ventilation, airspace, cleaning, drainage and water supply in the dairy and cow-shed. (3) Securing cleanliness of milk-store, milk-shops, sterilization of all utensils. (4) Cleanliness in milking, by thorough washing of udder and teats of cows, and (5) Precautions to be taken by dairymen, purveyors of milk and salesmen against infection or contamination at all stages. (6) Periodical and regular inspections by the sanitary authority and veterinary inspectors with regard to (*a*) health of cattle, (*b*) prevention of sale of milk from diseased animals, (*c*) weeding out tubercular ones. (7) Prevention of dairying in or upon living premises, and prohibiting

persons suffering from infectious diseases from taking any part in the trade. (8) Adequate facilities for keeping milk cool and for prompt and speedy transit and delivery. (9) Regulations for preventing aduiteration and impoverishing milk of its nutritive value; fixing of standards, milk not sold as skimmed, separated or condensed milk should be presumed to be not genuine if it contains less than (*a*) 3 per cent· milkfat, (*b*) 8·5 per cent. milk solids other than milkfat. Use of preservatives wholly interdicted. (10) The sale and use of condensed milk should be discouraged by every means, and its use for infants and invalids prohibited.

(16) Last but not the least important is prompt care and protection of milk in the home. Pasteurizing at the home is conveniently effected thus: Place the milk can, well-stoppered, in a deep saucepan, put some very hot water, put over fire until water comes to the boil. Remove saucepan and set aside for fifteen minutes; then cool rapidly. The temperature of milk barely exceeds 170° F. and its physico-chemical properties are not changed. The method is fool-proof. Milk should never be boiled. The can should thereafter be kept in a cool place, well covered and protected from flies, dust and other contamination.

In short, the consumer can control his milk supply by his demand; the trade ought to meet the demand; the local sanitary authority should play an active part in its control.

Colonial Medical Reports.—No. 189.—Bihar and Orissa.

ANNUAL RETURNS OF THE HOSPITALS AND DISPENSARIES IN BIHAR AND ORISSA FOR THE YEAR 1924.

By Lieut.-Colonel J. MASSON, M.B., F.R.C.S.E., I.M.S.

Officiating Inspector-General of Civil Hospitals, Bihar and Orissa.

THE year opened with 546 and closed with 580 hospitals and dispensaries of all classes, an increase of 34 against 61 in 1923.

The number of patients treated at the State public, local fund and private aided dispensaries rose from 3,586,552 in 1923 to 4,102,732 in 1924 The increase of 516,180 took place in the general and standing dispensaries.

The remarkable decrease in the attendance at the travelling dispensaries was due to the closure of some of these dispensaries whose retention was considered no longer necessary.

DISEASES.

The year under report was not so healthy as the previous one, the death-rate amongst the general population being 29·10 against 25·00 per mille. The increase in the mortality was for the most part due to the prevalence of cholera and small-pox in epidemic form during the year in several districts of the province.

Cholera.—The number of deaths from cholera amongst the general population which had decreased from 26,805 in 1922 to 8,198 in 1923, rose to 77,480 in 1924. The attendance at the hospitals and dispensaries also increased from 3,697 in 1923 to 25,435 in 1924. It is, however, satisfactory to note that in spite of the large increase in the number of patients admitted into the hospitals, the number of deaths amongst them was much less, being 344 only, as compared with 315 in 1923.

Plague.—This was less prevalent in 1924, the death-rate being ·3 only, as compared with ·8 per mille in 1923. The number of patients treated at hospitals and dispensaries was 3,298 with six deaths, against 4,770 and sixteen, respectively, in the previous year.

Small-pox.—The death-rate from small-pox was ·2 against ·09 in the preceding year. The dispensary attendance also increased from 407 to 675.

Malaria.—The total number of patients treated for malaria in hospitals and dispensaries was 1,139,005, as compared with 932,508 in 1923. These figures are in keeping with those for deaths amongst the general population from fever which numbered 660,635 and 599,840 respectively.

Influenza.—23,104 cases of influenza were treated in hospitals and dispensaries in 1924, against 26,439 in 1923. As in the previous years, vaccine was supplied by Government free of cost to all civil surgeons and superintendents of jails for use in the institutions under their control.

Venereal diseases.—The number of patients treated for venereal diseases decreased from 64,172 to 63,821. The grant of Rs. 12,000 sanctioned by Government for affording special treatment of these diseases was distributed to all Sadr hospitals and also to those sub-divisional hospitals where assistant surgeons are employed. The money allotted is spent with good result.

Kala-azar.—28,669 patients were treated for kala-azar in 1924, against 20,619 in 1923. The treatment by intravenous injection is being continued as usual. Arrangements are now being made for the treatment of this disease with orea stibamine, which is considered as being the most serviceable antimony preparation at present available.

Tubercle of the lung.—The proposal for the establishment of a sanatorium for the treatment of

tubercuIosis cases at Sabour has been abandoned as this place is not considered suitable for the purpose. An annual grant of Rs. 1,500 has been sanctioned by Government to the King Edward Sanatorium Dharmpore (Simla), for reserving one bed for the non-paying patients from this province. A scheme for the establishment of a sanatorium at Itki in the district of Ranchi has been put forward and is being considered. During the year under report 10,333 patients were treated in hospitals and dispensaries in the province against 8,924 in the previous year.

Filariasis.—The Filariasis Hospital at Puri was primarily instituted for the investigation and treatment of filariasis, but its scope has been considerably extended, and there is now in existence a compact unit doing magnificent work. All injections are carried out here. The three main investigations now conducted relate to (1) filariasis, (2) ankylostomiasis with the allied *Necator americanus*, and (3) *Strongyloides stercoralis*. In Orissa it seems essential that the latter parasites should be thoroughly investigated, as they probably account for the poor physique of the Oriyas

Leprosy and Leper Asylums.—In accordance with the resolution brought forward in the local Legislative Council in 1923, additional facilities for the treatment of leprosy at Sadr and sub-divisional hospitals have been introduced and the scheme is being given a fair trial. The results obtained will be reported in due course. The asylum at Lohardaga having been closed, there were nine asylums only at work and 8,225 lepers received indoor treatment at these institutions in 1924.

Operations.

The total number of surgical operations performed during the year under review at the State public, local fund and private aided hospitals and dispensaries was 249,507 with 378 deaths, as compared with 206,814 operations and 346 deaths respectively in 1923.

Radium Institute.

The work at the Ranchi Radium Institute has been carried on very satisfactorily under the management of Lieut.-Col. J. C. Vaughan, I.M.S. (retired). Two hundred and fifty-three new cases were treated during the year, against 189 in 1923.

Colonial Medical Reports.—No. 190.—Bihar and Orissa.

ANNUAL REPORT ON THE WORKING OF THE PATNA MENTAL HOSPITAL IN BIHAR AND ORISSA FOR THE YEAR 192

By H. R. DUTTON, M.R.C.P.Lond., D.T.M. & H.Camb., Lieut-Colonel, I.M.S.

Superintendent Patna Mental Hospital.

Population.

The number of patients at the commencement of the year under review was 284, i.e., 237 males and 47 females. Sixty-three males and 7 females were admitted during this year, against 65 males and 4 females (including two cases of readmission) in 1923. There were no cases of readmission during the year.

Recoveries and Discharges.

The total number of recoveries was 35. Besides, 2 were transferred to Gobra Leper Asylum (Bengal), 1 was made over to friends having improved, and 1 was so discharged "not improved." There was one case of escape.

The question of discharge of those patients (mostly females) who have recovered but are more or less friendless and homeless, is a difficult problem to solve. It is considered unwise to throw them out on the world, because if discharged the stigma of being in a mental hospital is likely to stand in their way of getting any employment or a shelter and in consequence they will gradually swell the number of beggars, or most likely of criminals or "readmitted" cases On the other hand, all authorities agree that they should never be kept within the precincts of a mental hospital where the surroundings are certainly not congenial and common humanity demands that they should be segregated from insane persons as soon as they are convalescent. Under existing conditions they soon contract an "asylum habit" and thus become a continuous burden to the State.

The desirability of construction of separate convalescent wards, outside the boundary wall of the hospital, is therefore suggested for the consideration of the Government, and the opening of classes in various branches of home industry under a properly trained work-master and work-mistress, and attention is drawn of the generous public to the urgent necessity of starting "Homes" and agricultural farms for these unfortunates.

Sickness and Mortality.

Three hundred and seventy-six patients, viz., 290 males and 86 females, were treated for diseases other than mental against 430 in 1923. The main diseases during the years 1921-24 show a decrease in their incidence, i.e., dysentery, influenza, malaria, ankylostomiasis, diarrhœa, tuberculosis, cholera.

Of 17 cases of ankylostomiasis, 8 were admitted

in the mental hospital with the infection, and 1 case was infected while staying in the hospital. The remaining 8 were from old cases who had recovered under treatment (several examinations of stool at different periods giving negative result) but amongst whom the disease either recurred or who reinfected themselves during the year.

It is always a difficult problem to keep down the incidence of ankylostomiasis and dysentery amongst the patients of a mental hospital, quite a considerable number of whom are of filthy habits, passing stools in wards, open paths or in the fields, drinking drain water, eating garbage and leaves, and are also of coprophagic and geophagic habits. Of tuberculosis 3 cases were admitted with infection.

There were 5 deaths, against 20 in the previous year. There was no case of death amongst the "Observation" cases. From available records it appears that the death-rate in 1924 has been the lowest since 1912.

Criminal Lunatics.

In this connection a few observations must be made in regard to "criminal lunatics." Except in those cases where the accused persons are too insane to draw the attention of the trying courts as to their mental condition, a plea of insanity is taken by the defence after some time has elapsed since the commitment of the crime, and the court then directs the investigation of the mental condition of the accused. It becomes an extremely difficult problem for the medical men concerned to form any opinion at the stage as to whether or not the accused was of unsound mind at the time he committed the crime, and even if he was so whether his unsoundness of mind was of such a nature as to have negatived his criminal responsibility. There is a possibility of miscarriage of justice one way or the other in such cases. Or cases may occur where no such plea of insanity having been taken, and the mental disorder being of a trivial nature at the time of trial to escape attention of the court, people have been convicted, but while in prison undergoing the sentence they show unmistakable signs of such types of mental disorder which cannot but be of a long standing in nature. Amongst people convicted of crime, but later showing symptoms of insanity, some suffer from dementia præcox, epilepsy and dementia paranoides. Now all will agree that the diseases mentioned above are of very, very long standing in nature, starting possibly from childhood. It becomes then a pertinent question to ask as to whether or not these crimes were the direct result of their diseases, and if so they should not have been convicted at all. Then again the question of "malingering" mostly among the convicts is a problem to be always kept in mind, the detection of which requires special observation and knowledge of mental disorders on the part of the prison authorities. It is not infrequently that cases of malingering have been mistaken for true insanity due to either want of special knowledge or intelligent observation or confusion of the convicts with the warders staff.

To obviate the above-mentioned defects all prison doctors should undergo a thorough post-graduate training in a mental hospital, and that they should examine and record the mental condition of all prisoners, specially the under-trial prisoners, no matter whether a plea of insanity is taken or not. And in case of the latter, if they have reason to suspect any unsoundness of mind, they should voluntarily inform the trying courts their findings and opinion.

Form of Insanity.—The principal types of insanity among the patients admitted during the year 1924 were imbecility, dementia præcox, manic depressive, confusional insanity, epilepsy, paranoia and dementia paranoides.

Etiological Factors.—One case was admitted who developed insanity shortly after an acute attack of malaria, and whose blood examination at the time of admission showed the presence of numerous malignant tertian parasites. His father was of a neurotic temperament, as was subsequently admitted by the patient, but in my opinion malarial toxin was the exciting cause. The other common causes were puberty and adolescence, climacteric, senility, child-bearing, mental stress and strain, malnutrition and starvation.

Race.—Fifty Hindus, 12 Mohammedans, 3 Indian Christians and five of other castes were admitted during the year.

Clothing and bedding.—An attempt has been made to issue dhoties, shirts and coats to all patients instead of the regulation prison garb formerly in use, viz., janghias and kurtas. Flannels and tweeds of various shades were purchased and warm coats were prepared locally, introducing greater variety of pattern and individuality in fitting. Sufficient number of blankets were issued, but no bedding could be provided owing to stringency of funds.

Diets.—An improved scale of diet was introduced and the total amount as well as the amount of staple articles of diet were sufficient. Milk was given to the vegetarians in place of fish or mutton. But I regret to say that the diet generally suffered from a depressing monotony owing to the lack of a properly equipped kitchen and insufficiency in number of trained kitchen workers. Much cannot be expected from one cook getting a pay of Rs. 12 who has to cook for 300 patients daily.

Amusements.—Due to the want of a recreation hall and available space for outdoor games "amusements" could not be properly developed. Patients were taken in batches to a theatrical performance which they enjoyed immensely. Musical instruments, gramophone records and playing cards were issued to them. The therapeutic effect of properly conducted amusements and of indoor and outdoor games cannot be overstated and it is hoped that in the new hospital at Kanke this department will be properly developed.

Colonial Medical Reports.—No. 191.—New Zealand.

MANDATED TERRITORY OF WESTERN SAMOA. ANNUAL REPORT OF THE DEPARTMENT OF HEALTH FOR THE YEAR ENDED MARCH 31, 1925.

By T. RUSSELL RITCHIE,

Chief Medical Officer.

Public Health.

The previous year was marred by an epidemic of bacillary dysentery, but this year has been the most satisfactory one experienced for many years. The territory was singularly free from serious illness or even minor epidemics. The figures given in the table of attendances at the hospitals and dispensaries throughout the territory do not indicate any increase in sickness. The natives freely avail themselves of the facilities offered for treatment, and report for very minor complaints.

Infectious Diseases.

The return given does not include all cases of infectious diseases occurring in the territory, but only those which have been reported by European medical officers, i.e., enteric fever, pulmonary tuberculosis, lobar pneumonia, broncho-pneumonia, measles, dysentery, influenza, leprosy, puerperal fever, chicken-pox, mumps, tetanus, gonorrhœa and erysipelas.

Note.—Of the twenty-eight cases reported as enteric fever, in only eight was the diagnosis confirmed by bacteriological or serological investigation. Of the forty-two cases of pulmonary tuberculosis reported, the vast majority are cases diagnosed clinically.

Ankylostomiasis.—During 1923, slightly over eighteen thousand natives were treated for hookworm. The treatment was then discontinued, as the pressure on the department for the treatment of yaws made it impossible to carry out both campaigns with the staff available. During 1924 fresh supplies of drugs were purchased from the International Health Board (Rockefeller Foundation), and treatment was recommended in November. During the remaining five months of the year 16,205 natives were treated.

Yaws (Framboesia tropica).—In April, 1923, as a result of the natives agreeing to a medical tax of £1 per adult male, free medical treatment was instituted, and steps were immediately taken to organize a systematic campaign against this disease. Although a considerable amount of work had been done before that date, systematic work was impossible, as most of the natives were not prepared to pay the charges made for treatment. This preliminary work was of value in disseminating amongst the population a knowledge of the (to them) miraculous results obtained from injections of novarsenobillon. It was found impossible to cover the whole territory in the year, but in those districts attended to 32,366 injections were given. This year the whole area was covered, and 21,222 injections given. The figures are more instructive when given in a different way. The "first round"—that is, the treatment of the whole territory for the first time—resulted in 36,304 injections being given, covering a period of fifteen months. The figure for the "second round" was 17,284. During the first round numbers of small children with primary and commencing secondary lesions were not offered for treatment, but during the year under review such children were offered much more freely. Such an impression was made on the natives by the results of treatment that the Fono of Faipules, or native advisory body, agreed to the introduction of stringent regulations for the control of this disease, and these regulations have now been passed by Order in Council in New Zealand, and will be enforced during the coming year.

Filariasis.—The Research Expedition of the London School of Hygiene and Tropical Medicine, under Dr. P. A. Buxton, continued its work during the year.

Leprosy.—During the year seven lepers were transferred from Samoa to the Leper Asylum on the Island of Makogai, in Fiji. These consisted of four Samoans, one half-caste French Samoan, and two Chinese labourers, all males. Two lepers, both male Samoans, died at Makogai during the year.

The number of lepers from Samoa under treatment at Makogai at the end of the year under review was: Samoans, five males, one female; half-castes, two males, one female; Chinese, five males; Rarotongan, one male; total, thirteen males two females.

In addition to the above, five lepers (one male and two female Samoans and two male Melanesians) are isolated in Western Samoa pending transfer to Fiji after the hurricane season has passed. While awaiting transfer these lepers are under treatment.

Vital Statistics (Samoan).

The year under review has been an exceptionally satisfactory one. The number of live births (1,900) constitutes a record for Western Samoa, and the number of deaths (766), although not a record, is well below the average. The marked absence of serious sickness and even minor epidemics, the provision of dispensaries in outlying districts, and the campaigns against hookworm and yaws, are all

factors in helping to bring about the present position. The reduction in the number of adults due to the influenza epidemic of 1918, and the increase in the percentage of children in the community, tends to an increase in the death-rate, but it is hoped that the child welfare campaign to be commenced during the coming year will gradually produce the opposite effect.

Population.

During 1924 the natural increase amounted to 1,134. The population at December 31, 1924, was estimated to be 34,817.

Births.

The births of 1,900 living children were registered during the year. This number of births is a record for Western Samoa.

Deaths.

The number of deaths registered during 1924 was 766. Last year's figures were abnormally high, owing to an epidemic of dysentery (bacillary). This year the number of deaths is considerably below the average. With a birth-rate of 55·38 per thousand it was to be expected that there would be an increase in the number of children dying in the first year of life. That such did not happen is shown by the infant mortality rate being only 155 per thousand births, a figure considerably below the average, and one which compares favourably with many more advanced communities. Since the chief loss of life in Western Samoa occurs between the ages of six months and two years, it is anticipated that the coming year will not be as satisfactory as this one, but steps are being taken to reduce the wastage at this period of life.

Report on the Laboratory, Government Hospital, Apia.—April, 1924, to March, 1925.

By P. A. Buxton, M.R.C.S., L.R.C.P., D.T.M. and H.

(*Expedition to Samoa from The London School of Hygiene and Tropical Medicine.*)

The laboratory has been mainly busied with research into filariasis and other conditions, and the research work is not included in this report. We have also dealt with such specimens as have been sent in from the wards and out-patient department, and it is these specimens alone which are the subject of this report. The following examinations have been made:—

Blood Examinations.—For filaria, 23; for filaria (positive), 7; red count, 1; white counts, 5; differential white counts, 25. Blood-cultures: negative, 8; positive (*Bacillus typhosus*), 1. Agglutinations: negative, 30; positive (*B. typhosus*), 9; (*Bacillus paratyphosus* A) 3; (*B. paratyphosus* B) 2.

Fæcal Examinations.—For worm-eggs: negative, 53; hookworm present, 96; trichuris, 55; ascaris, 24. For protozoa: negative, 8; lamblia present, 1; *Entamœba coli*, 3; *Entamœba histolytica*, 1. For bacteria: number plated, 26; *Bacillus pyocyaneus* found, 2; *B. paratyphosus* (non-agglutinating), 1.

Urine Examinations.—General, 133; for organisms, by smear, 3; for organisms, by culture, 2.

Various Examinations.—For leprosy: total, 26; positive, nasal smears, 3; skin-scrapings, 3. Pus: cultures, sundry, 15; smears, sundry, 16; smears, urethral, 8; smears, urethral, gonococcus, positive, 5. Gland-punctures, 3. Serous fluids examined 4. Smears from yaws cases, 25. Sections cut, 12. Post-mortem examinations, 4. Fluids for percentage of alcohol, 9. Sputa for T.B.: negative, 32; positive, 8; streptococci, positive, 1.

The following points deserve comment: There are a number of cases which clinically resemble typhoid, but from which no organism can be recovered by blood-culture early in the disease; these cases give negative Widal reactions later on. There is also a common type of enteritis, with or without blood in the stools, which cannot apparently be attributed to any of the organisms which generally give rise to these conditions. The two stools from which *B. pyocyaneus* (and no other abnormal organism) was isolated were those of mother and child, acutely ill at the same time. A second child died, apparently of the same condition, before the stool could be examined. There is much research yet to be done upon the intestinal bacteria in Samoa.

The only case from which *E. histolytica* was recovered was a sailor, native of Manahiki, who arrived in port suffering from amœbic dysentery. As O'Connor has already reported, this disease is rare or non-existent in Samoans. He only found *E. histolytica* in 9·6 per cent. of 229 stools examined.

Of the five urethral smears in which gonococcus was found, four were from pure-bred Samoan males. It is sometimes said that Samoans are immune; but possibly they are infected more often than we realize; but, if so, they certainly do not suffer from orchitis, strictures, and grave complications which would bring them into hospital.

The Treatment of Yaws (Framboesia tropica) in Western Samoa.

By John S. Armstrong, M.B.,

Resident Medical Officer, Apia.

Historical.

Wilkes, in 1839, describes an eruptive complaint called *ilamea*, which covers many of the children under the age of ten years, and particularly attacks the face and head. He says: "The mode in which it is treated is singular; the child is rubbed with the husks of the coconut until all the scabs are removed; a soft preparation of breadfruit is then applied, after which they are washed." This has

been the Samoan method of treating yaw papules until quite recent times, and may even now be practised in some of the outlying districts. The word *ilamea* was probably used in mistake, as the Samoan uses it only to describe an impetiginous condition of babies. In 1866 Pritchards describes the disease called *tona* (the present Samoan word for yaws) " which attacks the native children almost without exception." Kraemer believes that the disease has long been endemic in Samoa, because the oldest word that the Samoans have for the disease is *patu*, which is the word used in the Sunday Islands for yaws. This would indicate that the Samoans acquired the disease when they were in contact with this race—probably before the time of their migration to the Samoan Islands. On the other hand, Pratt gives the meaning of *patu* as " a fatty tumour," and does not mention it in connection with yaws. Königer believed that the introduction of yaws into the Samoan Islands was quite recent.

In trying to arrive at any decision in this matter two points seem worthy of note:—

(1) That every description of the disease in Samoa states that it is practically a disease of childhood, indicating a long period of endemicity.

(2) The Samoans certainly had an old name of *Lupani* for the disease, which was used before *tona* —the latter word probably came into use during the Tongan wars, the last of which occurred many years before the recorded arrival of Europeans in Samoa, and this is the only authentic record of an early contact of the Samoans with a foreign race.

On the whole, the evidence seems to point to yaws having been long endemic in Samoa, and probably the Samoans brought the disease to these islands or acquired it soon after they arrived.

The Treatment of Yaws in Samoa by European Medicines.

Davies, in 1892, reports that he successfully treated the chronic ulcers of the Samoans. Kraemar, in 1902, used potassium iodide and a local application of salicylate, as he states that he did not like to give mercury to children; but the effect of this treatment was reported successful merely on observations of a single case of secondary yaw rash. In 1910 Poleck stated that he was obtaining cures in twenty days by the use of potassium iodide 0·59 grm. and calomel 0·01 grm. internally, and mercurial ointment for ulcers. The cures by these methods do not appear to have impressed the Samoans, as they continued to favour their own method of treatment. Shortly before the Great War the German doctors started to give injections of arsenical compounds of the salvarsan type. These injections were probably given to only a very small proportion of the population, but were becoming popular amongst the Samoans.

During the military occupation of Samoa by New Zealand troops army doctors were sent round the islands to give novarsenobillon injections whenever it was reported that yaws was prevalent in a district. On these expeditions a single injection was given, and usually no charge was made. This did a great deal to popularize this method of treatment. When the Civil Administration was formed in 1920 these expeditions were continued, but it was noted that the effect of the injections did not last very long in a district. In order to try and make the cures more permanent each case was given three doses instead of one, but, as the cost of the drug was becoming a large item in the medical expenditure, it was decided to try and enforce the payment of fees for the injections. This caused a serious falling off in the number of cases treated. It was then decided to do the children free, but charge the adults the cost of the drug used; but even this led to very little improvement in the number of cases treated.

The desire for this method of treatment played a great part in prompting the support of the Samoans for the passing the Samoan medical tax, which has enabled us to give free treatment. That the passing of this tax has been of great help in combating yaws is shown by the following incidents: Two native officials sent requests that a doctor should be sent to their village to give injections for yaws, as the disease was very bad in the districts. The first official estimated that he had at least one hundred cases; the second did not mention any number. When the doctor arrived he found that there were eleven cases in the first village and twenty-three in the second; and on making inquiries he was told that the others had not come, as they could not pay the fee and were ashamed to ask for free treatment. Eventually a few more were collected and given treatment without charge. Under the system of free treatment at the first visit, eighty-six cases were treated at the first and 117 cases at the second village—and this in spite of the fact that injections were being given at villages every three or four miles, so that the cases in question were drawn from a district with a two-mile radius, instead of five or ten miles, as at the previous visits.

Treatment.—At the present time we give to each case of yaws three doses of novarsenobillon, with an interval of a week between each dose. This is the standard treatment given at all our hospitals and dispensaries (on one or two days a week) all the year round.

To make certain that the treatment is available to the whole population we send parties, consisting of a European doctor and one to three Samoan assistants, round the islands, who stop at every village, or at the central village when there are several within a short distance, and give the injections. On these medical excursions, or " malagas," as they are called, the name, age, village, and dose of each patient is recorded for future reference.

Dose.—The method of administering the drug is to dissolve 0·1 grm. of novarsenobillon in 1·0 c.c. of sterile distilled water, and inject from 0·5 to 6·0 c.c. as a dose, depending on the age and sex of the patient. 0·5 c.c. is given to children under one year that are in poor health, otherwise we start at 1 c.c., and this dose, up to 1·5 c.c., which is given

to children of three to five years, has often to be given into the buttock-muscles. The larger doses are given into the arm-veins with 5·0 c.c. as the maximum female and 6·0 c.c. as the maximum male dose. The same dose is given at each of the three injections.

Method of Administration.—These injections are practically all given by our native medical practitioner and the cadets that we are training to become native medical practitioners. They scrub their hands with soap and water as for a major operation, and then soak them in a solution of biniodide of mercury prior to giving the injections. The dose is given with a 10 c.c. "Record" syringe, and a 2¼ in. fine-bore rustless-metal needle, which are sterilized in carbolic acid, 1 in 20, then rinsed out in sterile water, and the requisite dose drawn into the syringe. The patient's skin over the vein is painted with tincture of iodine by an assistant, and the arm congested by holding a rubber tube round the upper arm tight enough to obliterate the superficial veins without obstructing the arterial flow. The needle is passed into the lumen of the vein, and a little blood is drawn into the syringe to make certain that the point of the needle is free in the vein, then the rubber band is released and the injection given. The syringe and needle are washed in carbolic, 1 in 20, followed by spirit, and the needle is then allowed to soak in spirit or carbolic while the syringe and another needle are rinsed out with sterile water for the next injection. The use of six to twelve needles in rotation allows one operator to give about fifty to sixty injections in an hour.

The intramuscular injection for babies and little children is given at a point midway between the crest of the ilium and the great trochanter of the femur.

On malagas, when distilled water cannot be carried, the water from the village drinking-well or stream is used after having been boiled in a clean kettle and allowed to cool. The drinking water throughout these islands sterilized by this method appears to answer just as distilled water.

Ill Effects from the Injections.—These may be grouped under two headings: (*a*) Immediate, within a few minutes or hours; (*b*) remote, coming on the following day or after.

(*a*) These consist for the most part in vomiting or fainting, with occasional headache. They are almost without exception due to the patient arriving with an overloaded stomach, or having hurried too much coming to the place of injection, with the result that the patient is hot, exhausted and has a rapid pulse. These cases appear to suffer no ill effects if not injected till the pulse is settled down.

(*b*) The remote effects may be classed as:—(1) Skin disturbances, such as erythematous rashes, followed in some cases by desquamation and often associated with a conjunctivitis. (2) Kidney disturbances, which usually take the form of a subacute, but may develop into an acute nephritis. This condition appears to develop much more frequently in the half-caste than with the pure Samoan children and has caused the only case of death that has been reported which could be attributed to the drug. This patient was very ill before the injection was given, so that the death was not entirely due to the drug. (3) Abscess formation: this is by far the most common ill-effect, and usually occurs in the buttock of the poorly-nourished, marasmic babies that are often covered with septic sores; but even under the conditions that are encountered on malaga the proportion of these cases is not high. For example, in the malaga mentioned later, where 1,892 injections were given, only one abscess formed. The buttock-muscles often remain brawny for some days, and in a few cases even weeks, after the injections, and the same may occur in the arm if the novarsenobillon leaks from the vein. (4) *Febrile* reaction; this may last from one to three days, but as a rule causes the patient little discomfort. On the whole the ill effects are very rare, only one case being affected for several hundred injected.

Effect of treatment on Yaws.—In November and December, 1923, to test the effect of this method of treatment, a district was selected whose population was rather isolated, so that the results would not be affected by the arrival of people from other districts. The outlet of this district led to Apia so that any cases that sought injection directly after the malaga would be recorded in the hospital books.

The total population of the district was 2,782, consisting of 1,387 males and 1,395 females. Of the males, 61 were infants under two years, 615 were classed as boys (two to seventeen years), 711 as adult men (over seventeen years); 727 were women over fifteen years of age. Notification was sent to the native officials that the malaga party would give injections at five selected villages—each on a different day—the village being selected so that approximately 500 people lived within easy walking-distance. The injections were given in the early morning of each day, and in the afternoon the party moved on to the village where the next injections were to be given; in this way injections were given every day from Monday till Friday, and on the Saturday the party returned to the other end of the district in readiness to start the second injections on the following Monday morning. This is the method usually adopted on these malagas.

Throughout the district 695 people were injected, consisting of 351 males and 344 females, who received 1,892 injections. The proportion of these cases to the population was slightly less than the average throughout the islands.

During this malaga the type of each patient's lesion was noted, as well as the dose, and any reason for giving less than the normal amount.

In August, 1924, a second malaga was made through the same district, and nearly all the cases were seen that had received injections on the first malaga, and from this source, together with those that had come to the Apia Hospital, it was found that 77 cases had relapsed, comprising 31 females and 46 males.

Colonial Medical Reports.—No. 191.—New Zealand (*contd.*).

Number of cases receiving one injection, 24; relapses, 4=16·6 per cent. Some of these cases did not belong to the district, and had left before the second or third dose was given, so that the proportion of relapses is certain to be inaccurate.

Number of cases receiving two injections, 135; relapses, 20=14·8 per cent.

Number of cases receiving three injections, 536; relapses, 53=10 per cent. Eight of the fifty-three cases received doses that were smaller than our standard dose for age, due to the patient having associated illness, such as mumps.

The cases were divided into the following types: (1) primary sores; (2) generalized secondary papular rash; (3) dermatitis secondary; (4) "crab" tonas; (5) secondary ulceration; (6) gummatous infiltration and ulceration; (7) synovitis; (8) dactylitis; (9) tibial nodes and sabre-blade tibiæ; (10) dermatitis, slaty; (11) plantar and palmar dermatitis; (12) hyperkeratosis.

Primary sores: The proportion of relapses in the few cases treated is very high. This is partly explained by the fact that four out of the six cases were so ill that they received only half the dose that they should have had for their age. Another case was a breast-ulcer on a mother nursing a baby which had the primary sore, and a generalized secondary rash, well-marked round the lips, which was so ill that it could only have a small dose, which did not cure the condition and probably led to the mother being reinfected.

The number of primary and early secondary rashes seen appeared to be so small compared with the numbers in the later stages that at the time of giving the second injection an order was given that all children under two years were to be brought up for inspection. At this inspection only one child was seen that had reached two years of age without being infected, but none was infected under the age of six months.

The reason given by the Samoans for not having brought their young children for the first injection was that they think three crops of frambœsial rash should come out before any treatment is given, and also fear the effects of injecting a young baby. This belief is gradually dying down, but it will probably be some time before the Samoan realizes that his children should come on the first signs of the disease.

The underdosing of the primary cases, although it did not cure the babies, had a marked beneficial effect both on the individual cases and in encouraging the populace to bring their children early, because the cases that we were allowed to inject on the first malaga were so ill that their parents brought them for injection as a last hope, and they all survived and were comparatively healthy, in spite of some secondary rash at the time of the second malaga, which seems to show that the injected children probably derived considerable benefit, although not cured.

Yaws condition commences by the skin on the dorsum of the hands and feet becoming dry and turning a slaty-blue colour. The superficial epidermis is then shed in large, thin flakes, leaving a tight atrophic skin below. This continues for some months, the proximal border gradually spreading up the foot and hand until it reaches well above the wrist and ankle; at the same time all the pigment is extracted from the skin first affected, so that the dorsum of the hand or foot will be leucodermatous, while the ankle and wrist are a slaty-grey. The condition usually starts in the third or fourth decade of life and may continue for many years. In the old-standing cases the process may extend half-way up the leg or fore-arm. On receiving injections, all exfoliation and cracking stop, the slaty colour of the skin disappears, and the whole of the skin becomes more supple and healthy. The leucodermatous patches remain permanently. There seems to be no tendency to recurrence, as is shown by cases that have been injected three years ago without recurrence.

Another condition affects either the soles of the feet or the palms of the hands—usually of adults. Generally the condition shows as a thickening of the skin, which is either punched out in what might be described as worm-eaten holes, or may simply have deep and painful cracks; or the skin may peel off in large, irregular flakes, with occasionally small deep-seated water-blisters in it. The condition is worst in the wet season, and we think that moisture is probably a necessity, if not the only cause, in many of the cases. It shows a great tendency to relapse every year at the same season, and does this in spite of all treatment. The reason for having so many apparent cures was that the first malaga was held in the wet season, while the second was just at the end of the following dry season. The injections seem to always give considerable temporary relief.

In another type there is very marked increase in the horny layers of the skin, usually seen in young adolescents in Samoa. The condition is not common and does not appear to be influenced by the season of the year; we believe that it is probably due to yaws. The effect of N.A.B. injections is variable, but these usually cause considerable improvement.

A large proportion of cases received treatment with potassium iodide as well as injections, but in cases treated medicinally at their homes it is always uncertain whether the medicines prescribed are taken as directed or even whether they are taken at all, so that no more mention will be made of this additional treatment.

The percentage of relapses in the earlier stages of the disease is much greater after only two doses than after three doses of novarsenobillon, and probably four injections would give still better results; but there is always the danger that if we make the cure too complete we may remove the immunity that an attack of the disease conveys against a second infection.

At the present time some 54,000 injections have been given on the three-injection system without causing a single case to become reinfected with yaws.

so that it may be fairly safely assumed that we are not removing the immunity conveyed by an attack of the disease. If the cases were completely cured and all immunity lost, it would seriously affect our campaign, for at present the primary and secondary stages of the disease are entirely confined to the children amongst the Samoans, and a cure that allowed of reinfection of adults would soon tend to lose favour, however good it might be, for large areas of the population can receive treatment for the condition only once or twice in the year at the most. When the medical service has expanded sufficiently to allow us to have native medical practitioners in every district of Samoa, so that cases can receive immediate treatment, then complete cure will be safe and will be the ideal treatment. But at the present time we endeavour to keep an immune adult population, by merely treating cases sufficiently to cure the infective primary and secondary rashes which may also prevent the occurrence of the disabling tertiary conditions. This, we hope, will allow a large proportion of the present children to reach adult life without becoming infected, and so gradually exterminate the disease without risking a serious epidemic of yaws amongst the adult population before we have the personnel to control it.

The immunity which an attack of yaws gives the Samoans in preventing their infection with syphilis, as stated by Parham, seems to be very great, as we have never seen a case of syphilis in a Samoan; and we think that it would be a crime to remove that immunity at the present time. By the time that the present children reach adolescence it is hoped that syphilis will have very largely been brought under control by the European races, so that the chance of its introduction will be very much less, and, even if introduced, the population will be under more close medical supervision, so that any outbreak would be quickly reported and controlled.

Conclusions.

1. That in the treatment of yaws, with a view to eradicating the disease, some system of free injections for the patients is essential.

2. That the system of three injections, which we practise, does not entirely destroy the immunity conferred by an attack of yaws.

3. That at present it is desirable to maintain a certain amount of immunity in the population of Samoa to prevent the introduction of syphilis.

4. That the system of three injections prevents a large amount of the sickness and disability in the Samoan population from yaws, although a small proportion of the cases still relapse, but this is preferable to a more thorough treatment which might remove the patients' immunity and allow of reinfection.

5. That Samoans can readily be trained to administer this treatment, and it has proved to be a safe remedy in their hands.

The Control of Mosquitoes in Apia, Samoa.

By P. A. Buxton, M.R.C.S., L.R.C.P., D.T.M.&H.

(*Expedition of the London School of Hygiene and Tropical Medicine to Samoa*).

I propose to record some observations upon the mosquito (*Ædes variegatus*, *Stegomyia pseudoscutellaris*) which carries filariasis in Samoa, and to confine myself rather strictly to what has obvious bearing on the question of reducing the numbers of this very dangerous insect. But before I discuss the specific measures for its control it must be understood that no work directed against this one species will be effective unless general anti-mosquito measures are also prosecuted vigorously. The success of any health campaign depends largely on the interest and help of the mass of the population.

The most irritating mosquito is not the day-biting *Stegomyia*, which is our special objective, but the virulent night-biting *Culex fatigans* and *Finlaya kochi*. As long as the *Culex* and *Finlaya* make night unpleasant, so long will people in general say that anti-mosquito measures are useless and irksome, even if a great reduction in the numbers of the more dangerous *Stegomyia* is effected. The principal breeding-place of *Culex fatigans* in Apia appears to be septic tanks and pit privies. It would be a very simple matter to screen with gauze the ventilators of the septic tanks; it would not be an enormous task to treat the pit privies with creosol once a month. The extermination of *Finlaya* is a simple matter, though I doubt if public opinion is ready for it; it can be accomplished by forbidding the growing of taro and tamu (*Colocasia* species) within the municipal area. This measure would be entirely successful, and no other measure would be the least use. Every taro plant holds a few ounces of water among the bases of the great leaves, and in every plant one can find the larvæ of *Finlaya*, and this is their only regular breeding-place. It would greatly assist in reducing the amount of taro grown if the water-level of the Taufusi Swamp could be lowered a couple of feet. Speaking as an amateur, I feel hopeful that the control of the mouth of the Mulivai by gates which could be shut at high tide would effect a great deal at small cost. The urgent need of dealing with this swamp must be apparent to anyone who gives attention to the matter. It occupies land which must be used as a town site, and which will greatly increase in value as agricultural land when it is drained; it makes the proper disposal of sewage almost impossible; above all else, it is a great potential danger, because if *Anopheles* were introduced from the New Hebrides or Solomon Islands, Samoa would be faced by such an epidemic as decimated Mauritius in 1867-68. The evidence tends to show that two species of *Anopheles* were introduced into Mauritius from Africa, over a much greater stretch of sea than that which separates Samoa from Melanesia; the result was the ruin of Port Louis and the coast zone, the emigration of the white population to

the hills, and the death of over thirty-two thousand people in two years. Once the Taufusi Swamp is drained, the accidental introduction of *Anopheles* will be less likely.

So much for the more general mosquito control, which will render life more pleasant, but which will not effectively reduce the numbers of any disease-carrier. Let us turn to the question of controlling the carrier of filariasis, *Ædes variegatus* (*Stegomyia pseudoscutellaris*), remembering that a large proportion of natives (O'Connor found a filarial incidence of 58·3 per cent. in 2,509 Samoans over fifteen years) are infected by it and suffer from the diseases associated with its presence in the body. The habits of this particular species of mosquito have already been studied by Doane and more recently by O'Connor. Since our arrival in Apia in January, 1924, my assistant, Mr. G. H. E. Hopkins, and myself have devoted a good deal of time studying its natural breeding-places, but we have done little more than confirm the findings of the earlier workers. The principal breeding-places are:—

(1) Coconut shells, both those which have been opened by man in cutting copra or for drinking, and also fallen green nuts opened by crabs and rats.

(2) Rot-holes in trees. The insect is by no means a domestic insect, and great numbers may be found in every uncultivated part of the island. The commonest rot-holes in town are those in kapok, candle-nut, fao (*Hibiscus tiliaceus*) and other trees which are pollarded and used as fence-posts. Breadfruit-trees are dangerous because horses gnaw the bark and let in the rot. Mangoes are dangerous because their great forks often hold several gallons of water. The steps cut in the trunks of coconut-palms often contain water and larvæ. The mangroves (*Rhizophora*) in the mouths of the rivers are full of little holes in which *Stegomyia* breeds in great numbers. This is quite a serious matter in Sogi and the west end of Apia generally.

(3) Cacao-pods, gnawed by rats, are an important breeding-place, but hardly matter in Apia, as so little cacao is grown close to the town.

(4) There are a number of breeding-places of less importance—holes in rocks (especially when full of rotten leaves) water-buts, old tins, &c. I have no evidence against the crab-holes on Mulin'u, and I have not yet found larvæ in the crown of coconut-palms.

After studying the mosquitoes for several months, I arranged with the chief medical officer to attempt the practical control of this insect in that part of the town between the Mulivai and the Vaisigano. The inhabitants are mostly white or half-caste, and were very willing to do their part, and the work was carried on as a large-scale experiment for six months. I reached the following definite conclusions:—

(1) *Ædes variegatus* was certainly greatly reduced in numbers.

(2) Health inspectors could very easily carry on the work, but they must be specially trained. It is not sufficient to look for unscreened cisterns, sagging gutters, old tin cans, and obvious breeding-places of that sort. One must search also for rot-holes, even little ones, and either drain them with a chopper or else fill them with stones and sand. One must also pay special attention to the clearing of scrub in paddocks, &c., around gardens. It is only when it is cleared that the coconut-shells become apparent and can be collected and destroyed. By clearing scrub the general ventilation of houses is also enormously improved and the collection of the copra is facilitated. By attending to rot-holes and the cutting of scrub a very great reduction in the numbers of this mosquito may easily be maintained.

It is quite impossible in the present state of knowledge to exterminate this insect, because the great forest areas, with their innumerable little rot-holes, are its stronghold. Any method, therefore, which can be used to reduce the numbers, even a little, is valuable. I propose to search in the New Hebrides for insects which might possibly prey on the larvæ of *Stegomyia* and be capable of breeding in the little rot-holes, &c., in which they are found. If such a predaceous insect could be found, and if it was not objectionable on other grounds, it would constantly be doing its bit, and doing it at no cost to the community.

(4) Public Health Regulation No. 5 is sufficiently clear and wide; I only made formal use of it on two occasions. If at any time it is revised it might be well (*a*) to include "rot-holes in trees" among the breeding-places listed in paragraph 4, and (*b*) to forbid growing taro and tamu within the Apia municipal area—if the time is ripe for doing so. It will also be necessary to take steps to cut mangroves regularly as often as they are big enough to have rot-holes in them. This would have to be done by the Government. There is presumably no responsible owner of a tidal mangrove swamp.

The Clayton Lane Technique used in the Field to Control Hookworm Treatment.[1]

By G. H. E. Hopkins, B.A., F.E.S.

(*Expedition to Samoa of the London School of Hygiene and Tropical Medicine.*)

The author was recently requested by the Administration of Western Samoa to carry out an investigation into the efficacy of the treatment now in use against hookworm infection among the native population. The experiments described below were made in fulfilment of this request. The results are thought worthy of publication because the Clayton-Lane technique has apparently not often been used in field work, and the much-used Willis technique is here directly compared with it. The form of the method used was that described by Colonel Lane ("The Mass Diagnosis of Anky-

[1] Reprinted from *Trans. Roy. Soc. Trop. Med. and Hyg.*

lostome Infestation," *Trans. Roy. Soc. Trop. Med. and Hyg.*, March, 1924), who instructed the author in the technique. It was therefore exactly as used by him. Colonel Lane also passed the apparatus used as being correct. It was made by Messrs. R. B. Turner and Co.

A series of fifty-four specimens from individuals taken at random from the patients and staff in the Apia Hospital, Samoa, was examined in order to compare the accuracy of the Clayton-Lane and Willis techniques. A number of these stools were also examined by the direct smear method. The Willis method is as follows: About a gramme of fæces is well mixed with saturated salt solution in the quarter-ounce tin container in which it is obtained from the patient. The tin is then filled to the brim with the salt solution and a glass slide is placed over it. After about twenty minutes the slide is removed and examined under the microscope, smear side up. Malakai, a Fijian assistant of Dr. S. M. Lambert, of the International Health Board of the Rockefeller Foundation, performed the examination by the Willis method, while those of the Clayton-Lane method was performed by the author. Malakai was expert in the Willis technique, having used it in working under Dr. Lambert for a considerable period.

Of the fifty-four individuals examined, the Clayton-Lane method showed fifty (92·6 per cent.) to be infected, while by the Willis method the number found affected was forty-seven (87 per cent.). From seven individuals who were lightly infected several specimens (nineteen in all) were examined by both methods on different days. Of these nineteen specimens the Clayton-Lane method showed fourteen (seven individuals) positive for hookworm while the Willis method showed only four specimens (three individuals) positive. It is evident that for very light infections the Clayton-Lane technique is much more accurate than that of Willis. One of the cases in which the Clayton-Lane method gave a positive result while that of the Willis method did not was that of Malakai himself. He was convinced that this was an error, possibly due to the carrying-over of an egg in the cylinder used for measuring the specimen of fæces, and to prove himself free from infection he took 3 c.c. of oil of chenopodium on his return to Fiji. The result was to demonstrate the accuracy of the Clayton-Lane method, for in his first day's stools he passed one male and one female *Necator americanus*.

On completion of this preliminary work the author examined a long series of Samoans living in Aleipata, a district at some distance from Apia.

The district was chosen because it had never received mass hookworm treatment. The population is a fair average example of Samoans living under normal conditions and not much in contact with Europeans. There are drop latrines over the sea in some of the villages, but the seashore and bush round the village are favourite places for defæcation. Furthermore, the taro patches are at a distance of some miles from the villages, and the soil in their neighbourhood must be heavily polluted. The cases were collected at random, except that no children apparently under twelve years of age and no persons who had previously had hookworm treatment were accepted. The procedure was as follows:—

Containers (the quarter-ounce tins used by the International Health Board in the Willis technique) were given out to the people through the head man of the village, and brought in by the individuals themselves next day. The number of eggs obtained from 1 c.c. of fæces from each individual by the Clayton-Lane method was counted, and each person was treated with a mixture of oil of chenopodium (one part) and carbon tetrachloride (three parts), the dose varying according to the age and health of the individual, but with a maximum of thirty-five minims of the mixture, given in an ounce of magnesium-sulphate solution (one part salts in four of water). After an interval of three weeks a second specimen was examined in the same way, and a second dose of the drug administered to each person. A third examination at the end of a further three weeks gave the result of this second dose. No complaints of ill-effects from the drug were received, and several patients stated spontaneously that they were much benefited by the treatment. The preparation of the stools for examination was done by a Samoan medical cadet, who performed the work quite satisfactorily after doing it under supervision two or three times. It was found that a trained microscopist can without difficulty count the eggs in about ten or twelve samples of fæces per hour, but this number varies considerably with the average severity of infection, specimens containing many ova taking much longer to count than those containing few (the heaviest infection found was 1,050 eggs per cubic centimetre of stool).

The specimens were centrifuged two at a time, and it was found that the centrifuger was able to keep the microscopist constantly supplied on the first examination, but not on the later ones when the average infection was lighter.

If a mere diagnosis of positive or negative were required a much larger number of specimens could be examined in the same time and a centrifuge with a larger number of buckets would be desirable. The apparatus is quite light, and could easily be carried from one village to another by one man. The only piece of apparatus required locally is a table on which to fix the centrifuge. Failing this a substitute can easily be improvised. Apart from the preliminary cost of the apparatus, the method is very economical, the only material required being a saturated solution of common salt. The counting of eggs in a heavily-infected specimen would be much facilitated by the use of an eye-piece micrometer ruled in 1 mm. squares. A drawback of the technique is that the salt solution used rapidly corrodes the aluminium arms of the centrifuge. This could probably be avoided by giving the arms a thick coat of paint or varnish or (better) using arms made of brass or some other metal not affected by salt.

Colonial Medical Reports.—No. 191.—New Zealand (*contd.*).

The results of these examinations are shown in the following table. Since Clayton-Lane does not claim that his method is accurate for ova of *Ascaris*, no special search was made for these, but a note was made when they were observed. The figures of ascaris infection are therefore only approximate.

In the columns headed "Total eggs" and "Average number of eggs per cubic centimetre per person," those individuals who did not come up for all three examinations are ignored. It will be seen from the table that the number of total cures resulting from one treatment was not very great, the percentage of infected persons being reduced to a little less than two-thirds of the previous figure. The reduction in the number of eggs, and therefore of a number of worms per individual was, however, very striking, in spite of the fact that in a few cases no change or even increase was observed. Such cases are probably accounted for by migration of hookworms from the lungs to the gut during the three weeks' interval, though it is possible that some were due to substitution of a specimen from a different individual before it was brought to the laboratory, since it was not practicable to actually supervise the filling of the tins. Every precaution was taken to avoid the sharing-out of one stool amongst several persons, and such points as the colour and consistency of the stool and the presence and severity of *Ascaris* infection were a useful check in doubtful cases. Such sharing-out was detected in one case, but it probably did not take place to a degree sufficient to vitiate the results.

	Hookworm			Ascaris		
	Number examined	Number infected	Infection percentage	Total eggs (294 persons)	Average number of eggs per cubic centimetre per person	Number infected	Infection percentage
Before treatment	333	322	96·7	21,108	71·8	113	33·9
After first treatment	309	183	59·2	3,201	10 9	22	7·1
After second treatment	294	110	37·4	585	0·2	26	8·8

The results of the third examination correspond well with those of the second, the percentage of infection being again reduced by about one-third, while the average number of eggs per specimen was very greatly reduced.

It would appear that while the effect of one treatment is very good, it is desirable that it should be followed by a second. It is doubtful if, under conditions of mass treatment, a third dose is desirable. It also appears that the Clayton-Lane technique can be usefully employed in the field to diagnose the residual infections after treatment has been given. For this purpose the Willis method is quite unsuitable, owing to its inaccuracy in the case of light infections.

Health Survey of Western Samoa, with Special Reference to Hookworm Infection.

By S. M. Lambert, M.O.,

Of the International Health Board of the Rockefeller Foundation.

Transmissible Diseases.

There is a list of thirty-three transmissible diseases which are notifiable: Anthrax, cerebro-spinal fever, cholera, dengue, diphtheria, erysipelas, enteric fever (typhoid and paratyphoid), leprosy, plague, puerperal fever, small-pox, typhus, scarlet fever, yellow fever, chicken-pox, encephalitis lethargica, influenza, measles, German measles, mumps, ophthalmia neonatorum, acute primary pneumonia, acute poliomyelitis, ringworm (scalp), scabies, trachoma, tuberculosis, tetanus, whooping-cough, dysentery, venereal disease, yaws, beriberi. The prevalent diseases are frambœsia (or yaws), hookworm disease, ascariasis, filariasis, bacillary dysentery, measles, chicken-pox, mumps, lobar pneumonia, tuberculosis, leprosy. Skin diseases, such as tinea imbricata and itch, and eye diseases are also very common. The Samoans have their own herbal remedies for these diseases, and use massage very largely for the relief of pain.

Frambœsia, or Yaws.—This disease occurs in every village, and so prevalent was it that one might say that hardly a single Samoan reached adult life without having suffered from the infection.

Hookworm Disease.—This will be discussed in a later section.

Ascariasis.—In children ascariasis is very common, and is the cause of a considerable mortality to the younger children, producing two types of illness, a form of broncho-pneumonia and an intestinal type, which has high fever, and then suddenly the patients go into convulsions or collapse and die—very much like a case of acute enteritis. In adults the worm does not appear to cause much disability.

Filariasis.—This disease is very widely spread through the islands. The most frequent clinical manifestations of the disease are lymphadenitis, with or without lymphangitis; filarial abscesses; while a certain proportion of cases develop elephantoid swellings of the limbs, and pudenda, and breasts in females. The large incidence of hydrocele amongst the natives is probably due to filaria worm. The microfilaria appear in the blood of the peripheral circulation at all times during the twenty-four hours, and of the six species of mosquito in Samoa, Dr. F. W. O'Connor was only able to incriminate one—*Stegomyia pseudoscutellaris*—as the intermediate host. This mosquito

bites at any time of the day or night, but is most active about sunset. An expedition under Dr. P. N. Buxton, from the London School of Tropical Medicine, will spend two years on the study of the prevention of filariasis in Samoa.

Bacillary Dysentery.—This disease is endemic in the islands, and occasionally gives rise to small epidemics, which tend to be fatal to the children, but do not cause much mortality to the adults. A small epidemic in 1923 was due to an organism of the Shiga group. Amœbic dysentery, if it exists among the Samoans, must be very rare, but there is an occasional case from the Chinese labourers, so that there is always the chance of its spreading throughout Samoa.

Measles.—This disease is probably endemic in Samoa, and recurs a mild epidemic form about every four years; on the whole the disease runs a mild course and has very few complications.

Chicken-pox.—Sporadic cases occur all through Samoa, and cause very little disturbance to the patient.

Mumps.—This disease is quite common amongst children of four to twelve years, and nearly always affects only the parotid glands; there are no records of any complications, and the disease does not appear to involve the genital organs of the male or the breasts of the female children. The inflammation of the glands is so slight that there is rarely any appreciable difficulty in opening the mouth.

Lobar Pneumonia.—This disease is very common in certain seasons of the year, and practically always seems to pick out the basal lobes. Cases treated in hospital do extremely well, the mortality being very low.

Tuberculosis.—Bone and joint tuberculosis is very rare amongst Samoans, if it exists at all Tuberculosis of the lungs is very common, and a fatal disease to the natives, and still more so the half-caste population, whose houses are often poorly lighted and badly ventilated. Amongst the Samoans there are lung infections which cause hæmoptosis and to some extent simulate phthisis, but no acid-fast bacilli can be obtained, and from their complete recovery after the case had been considered from a clinical point of view as hopeless, we think that they are probably due to another infective agent, possibly "bronchial spirochætosis," as spirochætes have been found in spare numbers in the sputa of some of these cases. In children tubercular peritonitis often associated with phthisis is fairly common, as also is tubercular meningitis.

Leprosy.—The first cases ever diagnosed as leprosy were diagnosed in 1892; these were two Chinese. The next cases appeared in 1896, and were in people who had come from Hawaii. So far as is known there was no leprosy known in Western Samoa previously, and from the evidence available it is reasonable to conclude that the disease was introduced from Hawaii. Altogether there have been only forty-six cases to date recorded, of whom twenty-three are Samoans. At the present time the administration is supporting sixteen lepers at Makogai, in Fiji. New cases as discovered are sent to Fiji once each year.

Itch.—Scabies is fairly common amongst the children of Samoa, and occasionally it is seen in cases suffering from some chronic ailment who have been neglected by their friends and relatives; but on the whole the adult population is very little affected.

Tinea Imbricata.—This and other ringworms are fairly common amongst the Samoans, but the incidence is not nearly as great as it is amongst the Melanesian and Chinese labourers employed on the plantations.

Eye Diseases.—Simple catarrhal conjunctivitis is common, but the most serious condition is the true Samoan conjunctivitis, which is very infectious, and spreads rapidly from village to village, beginning with itching, swelling, and marked chemosis of the palpebral conjunctiva, which, within forty-eight hours has a purulent discharge, associated with great pain and photophobia. The inflammation soon spreads down the naso-pharynx having involved both eyes. In default of proper treatment, ulceration of the cornea follows, and then, if the native treatment of scrubbing with coco-nut fibre is adopted, the destruction of the eye-ball is a very probable result, and is the reason of there being so many cases of blindness in Samoa. Clinically, the condition resembles gonorrhœal ophthalmia, except that there is very little constitutional disturbance. An intracellular Gram-negative diplococcus is very constantly found in the discharge. It is very noticeable that villages near a bathing-beach, or which have adequate bathing facilities, show few eye diseases. As soon as one leaves the beach, or where there are few bathing facilities, eye diseases become much more prevalent.

Venereal Diseases.—Syphilis, which has been reported from time to time amongst the Samoans is probably very rare, if it exists at all; the cases that have been reported having turned out to be a yaws condition. The Chinese coolies have a small percentage of syphilitic cases, but there appears to be no evidence of their having passed the infection on to the Samoans. Gonorrhœa of a very mild type seems to be fairly common, but gives disabilities to few, as it does not cause retention of urine in the male or stricture, while no cases of salpingitis of diplococcal origin have been seen in the female. The Gram-negative diplococcus, which causes the urethritis, may be the same organism that causes the Samoan conjunctivitis, but Dr. F. W. O'Connor, when working in Apia, found that it was the exception to find any organism in the urethra in the cases of conjunctivitis which would lead one to expect that the conjunctivitis is spread directly from one person to the next, or carried by numerous flies, which are very persistent in their endeavours to alight on the eyelids.

Mortality in Samoa.

In 1923 the births of 1,701 living children (Samoan) were registered in Western Samoa. The number of live births in 1923 is the second highest

recorded, the highest being 1,792 in 1912, with a population of 24,239. Stillbirths, of which twenty-one are recorded, are not included either as births or deaths.

The number of deaths registered during the year was 1,398. The increase was due to an epidemic of dysentery. The crude death-rate was 41·5 per thousand of mean population. Of the 1,398 deaths, 719 were of children who had not reached the age of two years. Nine women died in childbirth.

Yaws and Hookworm Control.

1. *History of Hookworm Disease in Samoa.*

In 1920 Dr. F. W. O'Connor, of the London School of Tropical Medicine, carried out a preliminary survey which showed that hookworm infection among the Samoans was almost universal. He reported that he found an infection rate of 85·1 in 286 examined, but this was in some cases from one specimen only, and that among those examined for filaria the eggs of hookworm were eventually always forthcoming. The largest number of worms found by him was 113.

Hookworm Control.

The institution of free treatment in April, 1923, made it possible to commence a systematic campaign against the disease. The campaign was based on the International Health Board model, which had been studied in Queensland and Fiji, and with films, lantern slides and charts purchased from them a commencement was made to educate the native to the necessity for treatment and for better sanitation. This continued till October, by which time 18,057 mass treatments had been given. The work went slowly at first. This was probably due to lack of confidence on the part of the natives, who still had a vivid recollection of the havoc wrought by the introduction, during military occupation, of influenza in 1918, in which many thousands of lives were lost. In the first three districts treated, with a population of 7,924, only 4,526 offered themselves for treatment, a percentage of 57; in the next five districts, with a population of 14,444, they became more alive to the value of the treatment, and there was no difficulty in treating 13,004, or 90 per cent.; 925 other people were treated in hospitals. These were all treated with carbon tetrachloride, two minims to the year to the apparent age of fifteen, when the adult dose of 45 minims was given. At first this dose was given followed by a purge of magnesium sulphate in two hours. Later the drug was administered in saturated solution of magnesium sulphate.

By October, 1923, the pressure of the natives on the medical staff for the free treatment of yaws became so great that the hookworm campaign had to be temporarily abandoned for the lack of personnel to handle the two pieces of work. At the beginning of the year the natives had agreed to an additional tax of £1 per head of adult males for free medical attention, and the treatment of yaws with its spectacular results appealed to them more than the hookworm work. Their views had to be heard to assure the successful collection of the first tax, and to gain their firm support to the medical department.

Dr. O'Connor found 35 per cent. of ascaris infection. Future treatments will be given of 25 per cent. of oil of chenopodium to 75 per cent. of tetrachloride to handle this infection as well. The dosage will be two minims to the year, with a maximum of thirty-five minims.

3. *Yaws Campaign.*

The conditions which led to the inauguration of the yaws campaign have been mentioned above. Yaws is probably the greatest cause, direct and indirect, of death among the Pacific races in the first two years of life. Its tertiary effects are the cause of much suffering and ill-health throughout adult life. The treatment of this condition in Pacific islanders is probably the finest demonstration to them of the value of western medicine. During 1923 the demand for injections was so great that treatment was given to all offering themselves; no attempt could be made to fine-comb the whole population. The result of the year's work appealed to the natives so much that the native Parliament of Faipules, or chiefs, agreed to the introduction of very stringent regulations for the control of this disease.

"Regulations in Respect of Yaws."

"Whereas yaws is a preventable disease very common in Western Samoa, responsible for much suffering and death; and whereas the Administration of Western Samoa is spending large sums of money in an endeavour to eradicate this disease; and whereas the co-operation of the Samoans is essential to the successful issue of this work:

"Now, therefore, these regulations are made by the Administration of Western Samoa in pursuance of the Samoa Act, 1921.

"(1) These regulations may be cited as the Samoa Yaws Control Regulations, 1924.

"(2) As from the 1st day of April, 1924, the disease known as yaws shall be a notifiable disease.

"(3) The father or the mother of any child suffering from yaws shall immediately report the sickness to the Pulenuu of the village.

"(4) The Pulenuu of each village shall immediately report all cases of yaws coming under his notice to the Resident Commissioner, Savai'i, or the Secretary of Native Affairs, Apia.

"(5) No child suffering from yaws shall be allowed to travel from its village to any other village, except for the purpose of being treated by a doctor.

"(5) No child suffering from yaws shall be allowed to enter or to remain in any other village than the one in which it usually lives, unless for the purpose of visiting a doctor.

"(7) The Samoan methods of treating yaws are hereby strictly forbidden.

"(8) Every child under the age of ten years shall be produced for inspection by a medical officer when required.

"(9) The parents of every child brought to a medical officer for treatment for yaws shall see that the child undergoes the full course of treatment prescribed by the medical officer.

"(10) No parent shall refuse to allow treatment to be given to any child suffering from yaws when a doctor is in the district.

"(11) Any person refusing or neglecting to obey the provisions of these regulations shall be liable to a penalty of £1 for every such offence."

During the first year of the campaign 32,336 injections were given. The work was recommenced in April, 1924, and during the four months ending July 30 12,000 treatments were given. The whole of Samoa will have been completed by the middle of October, when the hookworm campaign will be recommenced.

A yaws unit consists of a European doctor with two or three native assistants. They take out a supply of a few thousand doses of novarsenobillon, a sufficient quantity of distilled water, syringes, and a sterilizing outfit. The dose given is 0·6 grm. for an adult male and 0·5 for an adult female, and children in proportion. An area which will occupy a unit for five treatment days is selected. On the first round the doctor examines all cases offering themselves for treatment, selecting those showing any signs or symptoms of yaws, and gives them their first injection, making a careful list of the name and village. Saturday is spent in retracing his steps to the starting point of the week. The second and third weeks are spent in giving second and third injections to those previously treated. On the second and third occasions the treatments diminish in number, as the first injections in many cases clear up the obvious lesions and the native can see no reason for further treatment. The matter of more than one treatment was not pressed in the first round of Samoa, as the campaign was intended to be one of education as much as one of treatment. With the new regulations a complete course of three injections is being insisted upon. On the first round it took fifteen months to complete the whole population. The second round, with the improvement shown by the first treatments, will be completed in six months. In treating the whole population it was found that the average dose given was 0·45 grm. On the first round many young children were not brought forward, as the Samoan considered that the injection would only "drive in the disease." On the second round it is found that parents bring their children forward freely.

4. *Present Hookworm Survey.*

This work was rather limited in Samoa because of the short stay occupied by the trips of inspection, also by the fact that Dr. Buxton, of the London School of Tropical Medicine, had planned to make such surveys a part of his programme.

We had the opportunity of seeing the new Clayton-Lane method of diagnosing hookworm ova. Briefly, a definite amount of fæces, about 1 grm., is measured by a small metal ring grasped by long-handled forceps, and pressed repeatedly into different portions of the specimen. This, ring and all, is dropped into a centrifuge tube, gently shaken with water, the ring is removed, and the tube centrifuged a thousand times a minute for one minute. The water is decanted. The tube is refilled with saturated sodium-chloride solution to the very top, and is covered with a small, thick glass slide, which fits between four horns added to the ordinary container of the centrifuge tube. The centrifuge tube is ground to make close union with the glass slide. This is then centrifuged a thousand times a minute for one minute. The slide is then lifted from the tube and suspended drop downward on two plasticine pillars placed on a larger slide which is in the grasp of the mechanical stage. The eggs are thus usually seen in a clear medium lying close to the glass slide in one even plane. It is the most beautiful demonstration of hookworm ova that I have seen. Clayton-Lane has shown that the eggs left after the first slide are almost negligible. The smallest infection can be shown by this method, an excellent one for measuring the reduction of hookworm infection of a population in eggs per gramme after mass treatment. The only objection to this would be the difficulty of counting the masses of eggs in the small area in case of heavy infection. Another objection to this method for field work is that it is unreliable in diagnosing ascaris infection, which has become an important part of hookworm campaigns in many districts, and is unreliable for trichuris eggs. These do not seem to cling to the drop that is brought away by the glass slide after centrifuging, as they do in the Willis method of salt flotation in the usual container. Just what percentage of accuracy is obtained by the Willis method in the case of ascaris it would be interesting to know, but this is quite certain, that it is far more accurate than the direct smear and centrifuge method, or than the Clayton-Lane apparatus.

Having the opportunity, I was anxious to try the ordinary field technique of the Willis method against the accurate Clayton-Lane method of direct centrifuge flotation, to learn what our percentage of error in field work might be. I had with me Malakai, a native of Fiji, trained to the microscopic examination of fæces. While I was absent in Savai'i he ran a set of tests, using the ordinary field technique, even to the quarter-ounce containers for specimen. The plan adopted was that Malakai examined persons by this method, which is the Willis technique. A small portion of fæces, about 1 grm., is well mixed with saturated salt solution in a quarter-ounce container in which it is obtained from the patient. The container is then filled with the solution, and over it a glass slide is placed for twenty minutes or more, when it is lifted from the tin and placed under the microscope, smear side up. The eggs are found floating in the salt solution, which adheres to the slide.

Colonial Medical Reports.—No. 191.—New Zealand (*contd.*).

Each specimen examined by Malakai was usually examined by direct smear by a European assistant of Dr. Buxton. When Malakai's specimen was found negative the Clayton Lane apparatus was used by Mr. Hopkins to confirm it.

The only Fijian examined was Malakai, my assistant, who was sure, after his own examinations, that he had no hookworms. On the first examination the Lane method and the Willis method found him negative. On the second day Willis found him negative and Lane found one egg. Malakai was a little indignant, and on return to Fiji insisted on 3 c.c. of oil of chenopodium to prove his microscopy correct, thinking that the one egg of the Lane method was an added infection carried in by the long forceps carrying the ring of fæces. However, a very minute examination of two days' stools found one female and one male necator passed in the first twenty-four hours' motions. This seems to me a rather brilliant demonstration of the accuracy of the Clayton Lane method. In seven cases specimens were repeated to the number of nineteen specimens. In five of these seven cases Clayton Lane found a negative and a positive. In three of these cases Willis found a negative and a positive. It seems to me fair to say that where Clayton Lane finds a negative and positive in the same case the worm content is probably one female. And it seems to me fair to conclude also that the Willis technique is accurate down to the question of a female worm or two as done under ordinarily careful field conditions.

Fifty-four individuals were examined for hookworm ova by the Clayton Lane and by the Willis techniques. Clayton Lane and direct smear found fifty positives, and Willis found forty-seven positives, respective percentages of 92·6 and 87.

Where the question of hookworm ova alone is concerned, and it seems desirable to show the last one of these, Clayton Lane shows a beautiful accuracy. The Willis technique is accurate down to a worm or two.

I am told that the Lane method makes no claim to demonstrate accurately ascaris or trichuris ova, nor did it in Apia The Willis method does so more accurately than any other method of which I know.

In the South Seas specimens have to be examined within twenty-four hours or flotation methods are useless. Refrigeration is out of the question, and no proper method of keeping specimens for a period that lends itself to ready examination has yet been devised. The Clayton Lane method cannot be operated accurately by the average native assistant, in my opinion, nor can it be used to advantage away from mixed centres. The Willis method can be used anywhere, and the stupidest assistant cannot hinder its accuracy. The Willis method is several times more rapid than the Clayton Lane method, and infinitely more economical.

In selected areas Clayton Lane technique might prove valuable in checking the results of field treatments. The Willis method is the desirable one for field use where rates of infection are desired for decision as to mass treatments, and time and expense are objects, and where information is sought as to infections other than hookworm.

5. *Hookworms Recovered.*

Several individuals were treated and their worms recovered. The conditions were such that no opinion could be formed as to effects of dosage. One hundred and sixty-three hookworms were recovered, of which 161 were necators and two were ankylostomes. Some of those treated were Chinamen. The intestines of two pigs were washed and their worms recovered. There were no human hookworms among these. These worms have all been forwarded to Dr. S. T. Darling for more careful survey.

Discussion and Conclusions.

Discussion.

The average white man sits in the shade in the South Seas and talks of the lazy native, and criticizes Government for not compelling (always the same word) the native to do this thing or that which will benefit him (the white man), with never a thought for the native himself. In the first place, the native is not lazy when he is interested nor when he wants to hold a job. Where nature is so bountiful and the necessities of life are so easily obtained as in most Pacific islands, natives do not seek hard work any more than whites would under the same circumstances; but where conditions are more difficult, as they are in many districts, then the native has to work as hard as any white man. In Savai'i some villagers have their gardens at a distance of miles, and must carry in their produce on their shoulders. In many parts of Fiji and other islands natives have to work and will work at hard labour to support their families.

Every colony in the Pacific faces the problem of a decreasing native population in the face of a need for an increasing labour supply to develop these islands for their products, which have grown to be necessities of the food supply of the temperate civilizations.

The causes of the decrease of the population are, broadly, decay of custom and introduced diseases—both due to the entering of white civilizations.

The easy answer is the importation of Asiatics. This is undesirable for political reasons, and in almost all cases it will finally produce a problem more difficult than the present one. And they mean the earlier extinction of the Native races. The true answer to this problem, and the far-sighted one, is the care of the health of these peoples and their protection from new epidemics while we are ridding them of the effects of those already introduced and to which they have little immunity, as well as ridding them of two or more diseases which have been prevalent among them

for an indefinite period. We must gain their confidence and trust in Western medicine and civilization. We must instil new ideas and ideals of daily life to take the place of such old customs as are incompatible with their new life. The result of such an effort will be the large increase of the population and the final pressure of that population on the means of subsistence will furnish labour for the development of the islands in an increasing amount. The birth-rate among them is so large under normal conditions that with a death-rate lowered by preventive medicine population figures will soon show a large enough increase to produce plenty of surplus labour for white plantations or necessitate an enlargement of their plantations by the natives, with increased exports and imports for the country. Samoa is well along on the road to this happy condition with her increasing population of healthy, contented natives.

Conclusions.

In Samoa we have a long-visioned Administration which is giving every support to a strong native department and a modern department of public health, these two working hand-in-hand. Yaws is well under control, and may be eradicated in the near future. Hookworm control measures are well advanced, and will now be prosecuted with the vigour given to the yaws campaign. Adequate sanitation, proper latrines, and pure water supply are gradually being installed in all villages. Definite plans are undertaken for child welfare work in native villages with the new year.

Even thus early, these measures are being reflected in increasing populations of healthy, happy Samoans. A few years and they will mean dividends on the investment for the country, which after all, must be the criterion of the success of a humanitarian effort if it is to be enduring.

Colonial Medical Reports.—No. 192.—Trinidad and Tobago.

ADMINISTRATION REPORT OF THE MEDICAL INSPECTOR OF HEALTH, TRINIDAD AND TOBAGO, FOR THE YEAR 1924.

Population.

The mid-year population has been estimated by the Registrar-General as 379,965, and this figure has been used for calculating the rates.

Births.

The number of births registered was 12,791—6,479 males and 6,312 females.

Deaths.

The number of deaths registered was 7,609—4,104 males and 3,505 females. This rate is the lowest yet recorded, and shows a decline on that of last year.

Infectious Diseases.

Enteric Fever.

The outstanding occurrence of the year was the increased prevalence of enteric fever. 1,012 cases were notified, an increase of 371 on last year and of 189 on the mean for the five years 1919-1923. There were 209 deaths.

The distribution was general. Of the nineteen sanitary districts, twelve showed increases of cases amounting to 388 over the notifications of last year, while in the five which showed decreases the cases were fewer than last year by twenty-four.

It is apparent that (1) the area most heavily affected included Port-of-Spain and the more populous districts in the northern half of the island; (2) Generally the period of greatest prevalence was during the earlier dry months in the northern area, but during the wet months in the southern area of the island.

In the year under review, cases were reported generally from different parts of districts, but frequently definite grouping following on the introduction of a first or fresh case occurred as in the following instances: (1) A young man living in Port-of-Spain took ill with fever in January. He was seen once by a doctor, but continuing ill was taken by friends early in February to a village in the country. He improved slowly. Towards the end of February a young woman, an inmate of this house, developed fever, and was removed to the house of relatives in another village. About three weeks later four persons contracted fever here. These cases were notified as enteric and subsequently nine other cases occurred. This was the first appearance of enteric fever in this village. (2) A woman living at St. Joseph took ill with fever. Medical aid was not sought and the case was removed to the house of relatives in another district. About a fortnight after arrival there a brother living in the house developed fever. A doctor was then called and both cases were certified as enteric fever. Shortly after four persons in three separate houses in the immediate neighbourhood contracted enteric fever. There had been no case in that area for over a year. (3) A young woman went from one district to another to assist in nursing her sister—a notified case. On her return home she developed enteric fever and several other cases soon followed.

Source of the Outbreak.—Detailed investigations

were made, but the results obtained, except in instances similar to those given above, do not warrant a definite statement as to source.

The relation of milk to the outbreak was carefully considered. The greater part of the milk supply throughout the colony is derived from small dairies in which methods of production and distribution are unsatisfactory. Many of these dairies have no regular customers, the milk being "hawked" and sold by retail. Detailed inquiry failed to discover any evidence of the occurrence or grouping of the cases which could be regarded as incriminating the milk-supply. From the nature of the circumstances such an investigation was difficult and unlikely to give definite results, but the conclusion that milk did not contribute to any important degree to the spread of the outbreak also receives support from (*a*) the almost universal practice of boiling cows' milk; and (*b*) the extensive use of condensed milk.

The general high endemic rate, the general prevalence of malarial fever, and the disinclination of the sick in many instances to seek or to return for medical advice, are factors which contribute to the number of unrecognized cases and carriers, and so increase considerably the difficulties of investigation. In this view the method and rate of progress of the outbreak and its occurrence in the earlier dry months—when general contamination of water supplies is unlikely—are significant and point to contact, direct and indirect, as the most important means of spread.

Control. — The measures recommended and adopted generally were: (1) removal of cases to hospital; (2) attention to personal and general cleanliness (including the care of articles of food and removal of refuse); (3) supervision and control of water supplies; (4) improved latrine accommodation and regular oiling of cesspits; (5) inoculation. The measure which gave most benefit was inoculation.

As frequently happens, when cases appeared to be increasing, contacts and others readily came for inoculation, but as cases subsided interest waned. This is unfortunate—inoculation is given free of charge, causes little or no inconvenience, and does not entail absence from work—as in a civil community the benefit derived will be in direct proportion to the interest and co-operation given by the general public. Its value in limiting the spread of enteric has been evident on several occasions; the following example has been selected on account of the rapid and striking effect: Enteric fever has been generally prevalent in the Tacarigua District for several years; the mean monthly number for the last five years was eight. In December, 1923, of twenty-nine cases seven occurred in El Dorado Village, nearly all the residents of which worked on the Orange Grove Estate. In January cases continued to occur—five were notified during the first half of the month. At the suggestion and with the willing and active co-operation of the manager of the estate, the inoculation of the population (about 800) of the village was undertaken and carried through rapidly and smoothly. The fourteenth and last case was notified on January 26, and from that date no case has been notified from that area. Cases continued to occur in the Tunapuna portion of the village and inoculations were extensively done around and about each case, with the result that cases became fewer and no case has been notified from the district during the first four months of this year (1925).

Tuberculosis.

There were 524 cases of pulmonary tuberculosis and 480 deaths registered. Of the total notifications 178 were from Port-of-Spain and 218 from the other towns and large villages in the following order: Couva forty-seven, San Fernando thirty-seven, St. Joseph twenty-nine, Princes Town twenty-four, Tacarigua twenty-three, Diego Martin twenty-one, Manzanilla twenty-one Chaguanas sixteen. No case of tuberculosis other than pulmonary was notified.

Pneumonia.

349 cases were notified with 188 deaths—113 from urban and 236 from rural districts. The cases occurred generally over the colony and throughout the year.

Chicken-pox.

Fifty-one cases were notified—sixteen from urban and thirty-five from rural districts. There was no death.

Diphtheria.

Forty-one cases were notified with four deaths—twenty-seven from urban and fourteen from rural districts.

PRINCIPAL CAUSES OF DEATH.

Deaths from the ten principal causes were 253 fewer than last year, due to the decrease in deaths in the non-tuberculous group of the respiratory diseases. The other diseases showed increases which in the following cases, malaria, diarrhœa and enteritis, nephritis and Bright's disease, are slight.

Malaria stands out as the principal cause. The increase (viz., 2) over last year is small, and the figures show a definite downward trend.

Diarrhœal diseases come next in order to malaria. The increase on last year is small, but the total deaths show definite improvement on the preceding years.

When considered as a group the principal causes show definite improvement on the previous six years.

SUMMARIES OF REPORTS OF THE MEDICAL OFFICERS OF HEALTH.

Diego Martin District.

With the exception of the increase of the numbers of enteric cases chiefly from Maraval and St. James, there has been no serious epidemic of infectious disease.

An anti-enteric inoculation campaign was carried out during the year of adults and children in the district from Four Roads backwards, the same procedure will be adopted for St James in 1925.

As regards enteric fever it can be noticed that

its periodicity coincides with the change of weather, i.e., towards the end of the dry season with a rise as the wet season establishes itself. As regards its spread—from the fact that cases occurred at such distances and such length of time from each other, one can more or less exclude the fact that the spread of infection is due to anything connected with the water supply or milk.

The climatic conditions as they exist in the Maraval Valley are extremely favourable to the growth of enteric bacilli. Its spread is largely due to: (1) infection carried by flies and other insect pests; (2) direct contact; (3) human carriers.

As regards St. James its condition from a sanitary standpoint is not at all satisfactory: (1) The streets need repair and are badly kept, the drains, large and small, always contain stagnant water in the wet season with the addition in parts of decaying animal and vegetable matter, and the sanitary inspector should be commended for the manner in which he manages to keep this nuisance in check and make it more or less tolerable. (2) Owing to the large number of cowpens in this area there are of course numerous breeding grounds for flies in the manure heaps, thus providing a dangerous and rapid agent for the spread of enteric fever.

St. Joseph District.

There was a more than usually widespread epidemic of enteric, the highest number of cases taking place in January and the smallest number in September. In spite of the investigation of milk and water supply no special source of infection was discovered. The main source of infection was from Port-of-Spain. Otherwise the health of the district was generally good.

Malaria fever has not been so prevalent as in past years.

The routine habit of treating all hospital cases and out-patients with tetrachloride of carbon was adopted, and on Caroni Estate a mass treatment of the labourers carried out. This has tended to the general health improvement of the inhabitants.

The milk supply and dairy conditions were constantly supervised and a general, if slow, improvement in sanitary conditions is reported. At the end of the year there were ninety cowsheds with concrete floors.

Cesspits were constantly visited and there is an improvement both in the building of them and in the condition in which they were kept.

Antimalarial measures were carried out as far as the money available allowed. But in this one has to rely mainly on the gradual education of the people to the necessity of co-operation with the efforts of the sanitary inspector.

Tacarigua District.

Enteric fever was prevalent among people of all ages and both sexes and was distinguished for a plurality of cases among families and contact from family to family. Histories were clearly traced. In view of the fact that carriers carried the disease long after their recovery, preventive inoculation as a permanent measure against recurrence is recommended. This was performed on 5,237 occasions, particularly among contacts during 1924. No one was turned away. It is too early to pronounce positively on the efficacy of this measure, but evidence of its success is not wanting. A fully organized plan of campaign has not yet been developed. It would be well to stabilize the measure along certain definite lines.

So far as one can judge the incidence of dysentery was particularly mild. The same may be said of influenza.

Tuberculosis ranks among the major causes of death and is favoured by the overcrowding referred to.

Vastly in excess of all the preceding—not so much as a cause of death as of ill-health and incapacity of work—appears syphilis.

Yaws, too, is fairly common. The relationship of the two diseases is disturbed. As one recedes from the towns to the country-side, yaws is the more abundant and syphilis diminishes.

St. Andrew District.

The health of the population has been fair. Malarial fever was very prevalent during the months of August, September, October and November.

There was also more dysentery than the year before.

On the other hand, the number of cases of influenza and pneumonia was very much smaller than during 1923.

There were twenty-eight cases of typhoid as compared with twenty-nine cases the year before. Inoculation of contacts was performed on an extensive scale.

The water supplied by the pipes from the Quare River continues to be satisfactory.

St. David District.

There were no circumstances affecting or threatening the health of the district.

Six cases of infectious diseases were notified during the year. Of this number one was a case of enteric fever from Grande Riviere. The other five cases were individuals suffering from pulmonary tuberculosis. There are no waterworks in the district, the inhabitants of which derive their supply chiefly from rivers. In parts of the district where rivers and streams are not easily accessible, rain water stored in cisterns, tanks, and barrels is used. The villages of Grande Riviere and Matelot are plenteously supplied with good potable water derived from rivers and streams. The villagers of Sans Souci are entirely dependent during the dry season on that part of the Sans Souci River above the village and the Betty Ravine. During this season the inhabitants of Toco, especially, and of Cumana are very hard put to in obtaining water for their domestic use. In the former village a single well supplies many a home, while in the latter villages the Tompire River—some little distance away—supplies the needs of the thirsty villagers. On the whole the quality of the water in the rivers and streams is good.

Colonial Medical Reports.—No. 192.—Trinidad and Tobago *(continued).*

Chaguanas District.

There was no epidemic nor any case of disease of an unusual or grave character.

Malarial fever of the benign type was prevalent throughout the year.

A good many cases of chronic bronchitis and ankylostomiasis were also treated.

Seven cases of enteric, fifteen of pulmonary tuberculosis and one of diphtheria occurred during the year.

Couva District.

The chief diseases causing the majority of deaths were: ankylostomiasis forty-seven, bronchitis thirty-six, malaria twenty-one, nephritis fourteen, diarrhœa twelve, dysentery seven.

The number of infectious cases notified were: enteric fever forty-nine, lobar pneumonia nineteen, broncho-pneumonia nineteen, pulmonary tuberculosis fifty-eight.

Ankylostomiasis was the cause of the largest number of deaths despite the fact the Hookworm Commission were still at work in the district.

Couva is much in need of a pure water supply.

Malaria, of course, is the prevailing disease, and is of the benign tertian type.

Venereal diseases are prevalent, especially gonorrhœa and its sequelæ.

Naparima District.

Water Supply.—For a period of the year ponds furnished the water supply in nearly all the villages. This, however, is impure, and during the dry season it becomes worse and scarce.

Latrine Accommodation.—In the majority earth closets are used, and I am now pleased to say that on all estates suitable latrines have been provided for the labourers.

Scavenging.—Seven villages are now scavenged by a cart.

Gran Couva District.

Drinking water is obtained in the wet season from rain water and in the dry season chiefly from rivers, springs and shallow wells. The rivers and shallow wells are contaminated by surface washings, but there are some satisfactory springs. Swamps and drains at Flanagin Town were regularly oiled and opened, resulting in a marked reduction of mosquitoes. There is a great improvement in latrine accommodation in the large and important villages of Flanagin Town, Mamoral, Brasso and Capara. A weekly scavenging service was inaugurated in March, 1924, at Flanagin Town. As a result there has been a decided improvement in the general cleanliness of yards, including shop premises.

Guaracara District.

The Princes Town Waterworks supplying about half the district, has been in constant operation throughout the year, and the water supplied, although somewhat hard, is otherwise good and sufficient. The remainder of the district is supplied by ponds and springs, the ponds representing rather less than one quarter of the total supply, being the only one open to serious objection.

Ankylostomiasis.—In addition to the intensive treatment of frankly ankylostomiasis cases, it is the practice in the absence of contra-indications to combine ankylostomiasis treatment with the preliminary purgation of all cases of illness, and about 20 per cent. of such cases are treated a second time. This, together with a progressive improvement in latrine accommodation, is causing the position, as regards ankylostomiasis, to steadily improve.

Malarial fever was very prevalent during the second and last quarters. The chief sources of mosquitoes are (1) the small, artificially constructed rice marshes with which the district is honeycombed, and (2) the storage of rain water. While the rainfall is abundant, these are constantly overflowing and being washed out; but at the beginning and towards the end of the rainy season the showers serve to keep just enough still water in them to afford ideal breeding places for mosquitoes.

The fever is chiefly of the benign tertian type with scattered malignant cases.

Princes Town District.

Water Supply.—A pipe-borne water supply from Montserrat hills was available on the northern portion of Savana Grande, including Princes Town, throughout the year. The quantity is satisfactory, the quality of water for drinking purposes is good, but its high degree of hardness prevents its use when rain water is available. As this pipe-borne water supply is not the only water used in the area of its distribution, it is difficult to record the result of this pure water supply on this given area. It is worthy of note, however, that whilst many cases of typhoid fever and dysentery occurred in the district beyond this water supply, the area supplied by this water service had very few such cases throughout the year.

Ortoire-Moruga District.

Malaria.—The circumstances which influence the prevalence of malaria are briefly (1) swampy lands in Tableland and Moruga districts, (2) ponds and pools with leaves and twigs, &c., at their edges, grass-grown earthen drains in cultivated lands and borrow-pits in all the sub-districts. Remedial measures of drainage of swamps and regular cleaning of the ponds and pools should be undertaken.

Water.—There is a standpipe service from the Princes Town Waterworks. This supplies a small section of the district on the Naparima-Mayaro Road. Elsewhere the people get their water supply from ponds, pools and wells which are all liable to pollution.

Nariva-Mayaro District.

A greater number of malaria and ankylostomiasis cases than usual were seen, probably due to the

large increase of pauper work at the various health offices. Biche health office was added to this district in January, 1924. The source of water supply continues to be ponds, shallow wells, and, in a few cases, tanks, cisterns and barrels.

Erin-Siparia District.

The lowlying nature of the country with abundant swamps, sluggish rivers and unavoidably insufficient drainage, and the existence of large areas of uncultivated land, are probably the principal factors causing the large incidence of malaria. Inquiry was made into the manufacture of aerated waters. No sickness can be traced to impure aerated waters, but this question needs careful attention. Scavenging has been systematically carried on at Erin, Siparia and St. Mary's Village, Oropuche.

Brighton-La Brea District.

(1) *Brighton.*—The bungalow area was maintained at its usual high standard of sanitation. At Coon Town there remain ten barracks (housing 127 men, 89 women and 114 children), which it is hoped to eliminate altogether at an early date by a further addition to the model village of New Jersey. The latter, which was first occupied in September, 1922, and is equipped with every modern sanitary requirement, still continues to be an object lesson to the neighbouring population. The cottages are neatly and tidily kept, and, with a few exceptions, possess a well-cared-for flower or vegetable garden, whilst there is every evidence of cleanliness and order in the family and bachelor barracks.

(2) *La Brea.*—Much useful work of a permanent nature was performed during the year, and certain parts of the village show a presentable appearance, but Corbeaux Town and Ladysmith are, unfortunately, still with us as landmarks of what an insanitary village can be.

Cedros District.

Water Supply.—The dry weather was a very severe one for 1924. For fully ninety days there was not an inch of rain recorded at Bonas and Fullerton villages, and the majority of the people had to resort to wells, ponds and rivers for water. Fortunately there was no epidemic of intestinal diseases.

As it is a source of difficulty and expense to get enough water for the people of these villages during the dry season, some economical method of providing drinking water has to be seriously considered by the Government, and after taking everything into consideration as to the cheapest and a wholesome method of supplying water to the people, the building of at least six cisterns of about 20,000 gallons capacity each, in different parts of the villages, is recommended, the water to be collected from the roofs of houses, government and private, and with a view to prevent waste, and also to provide cost of upkeep for cleaning cisterns, &c., the people may be requested to pay a small sum —say one cent. for every bucket of water taken—as is reported done in other parts of the colony.

The inhabitants of Granville and Chatham do not appear to suffer to such an extent as they have a greater rainfall in these parts and more rivers and springs.

Scarborough District, Tobago.

During the year under review there were twenty-nine cases of enteric fever with six deaths. Of the twenty-nine cases all but two occurred in the first half of the year. It was noteworthy that the highest incidence occurred at the end of and in the first few weeks of the wet season. Last year thirty-seven cases and the year before fifty cases occurred, so that the incidence, unlike that in Trinidad, can be considered to be on the wane. With the installation of a pipe-borne water supply in this district, I expect to see very few cases in the future. The usual preventive measures were followed, importance being placed mainly on (*a*) inoculation of contacts, and (*b*) insistence on immediate removal to hospital. All the cases occurring in this district were treated in hospital.

Malarial fever was unduly prevalent, especially in the latter part of the year—July to October. Fifty-seven cases were treated in hospital with one death (a case of malignant malarial fever from the windward side).

The number treated in hospital represent about 20 per cent. of those seen in the health offices.

During the year the Ankylostomiasis Commission worked in this district completing their labours about April. Their attentions have been directed to the other two districts.

This district was not among the heavily infected ones; a bad case is rarely seen. With the more efficient tetrachloride of carbon treatment, it should be easy to deal effectively at least with all the cases presenting obvious signs of the condition. In connection with the campaign, and prior to operations being started, a large number of new latrines were installed. This, in conjunction with the educative measures accompanying same, should tend to raise the sanitary tone of the district. During the latter part of the year a preparation of pot. sod. bism: tart. was used for the treatment of yaws instead of the novarsenobillon and neosalvarsan preparations. It has on the whole proved satisfactory and is at least, so far as a short trial can be used as a criterion, equally satisfactory as the arsenicals. It has further the advantage of being very much cheaper; of causing much less pain by the intramuscular method. A point that deserves notice is that it is in my experience more satisfactory than the arsenicals in the treatment of the chronic ulcer type of cases.

Roxborough District.

There has been no epidemic outbreak of infectious disease throughout the year. Fourteen cases were notified, of which three were cases of enteric fever. Two cases suspected to be enteric fever and notified as such turned out to be [illegible]

enteric fever. Of the remaining, nine were cases of pneumonia (4) and pulmonary tuberculosis (5).

Yaws continues to be exceedingly prevalent in this district.

Much difficulty is still being experienced in getting cases to attend for treatment uninterruptedly until cured.

Water supply is from streams, rivers and wells. This is plentiful during the rainy season, but there is no adequate storage supply to use during the dry season. All streams and rivers in the neighbourhood of houses in the hilly portions of the district are open to pollution. Except the setting aside of certain portions of certain streams near their mouths for washing purposes, &c., no steps have been taken either by the local authority or the Government to prevent pollution. Action was taken by the sanitary inspector in three cases, at Delaford, Charlotteville and Parlatuvier Roads. Two defendants were fined £1 each, the other reprimanded and discharged.

During the latter months of the year the Hookworm Commission, locally superintended by Dr. Bishop, worked in this district. Cases of ankylostomiasis now presenting themselves for treatment are few and far between and there can be no doubt whatever that the work of the Commission has been productive of much benefit. Indeed, it appears that the repetition of such a campaign at stated periods must eventually lead, together with improved sanitation, to the complete eradication of this dread and debilitating disease.

Colonial Medical Reports.—No. 193.—Ceylon.

REPORT OF THE PRINCIPAL CIVIL MEDICAL OFFICER AND INSPECTOR-GENERAL OF HOSPITALS FOR THE YEAR 1924.

POPULATION: PUBLIC HEALTH.

The estimated population of Ceylon on December 31, 1924, inclusive of immigrant coolies, was 4,861,670. 10,005 of these were Europeans.

Vital Statistics.—178,866 births were registered, as compared with 181,441 births in 1923. 122,959 deaths were registered during the year, 141,894 the previous year; a decrease of 18,935 during the year under review.

The more notable causes of death were the following diseases: Infantile convulsions, 13,899; diarrhœa, 9,026; pneumonia, 8,339; rickets 4,078; intestinal parasites, 3,246; anæmia, 2,692; dysentery, 4,080; phthisis, 3,235; dropsy, 2,580; malaria, 1,388; anchylostomiasis and its sequelæ, 1,853; puerperal septicæmia, 1,322; enteric fever, 816; tetanus, 269; rabies, 37; deaths attributed to pyrexia of unknown origin, 17,697.

A large number of the deaths registered under pyrexia of unknown origin were most probably due to malaria, as this disease is prevalent in the greater part of the island.

Malaria was prevalent to some extent during the year, and showed a slight decrease as regards hospital admissions and cases treated at dispensaries and hospital out-patient departments from the large numbers of the previous year.

26,856 hospital admissions and 925,476 dispensary cases were recorded during the year.

1,388 deaths from malaria were registered in 1924, but 17,697 deaths in 1924 were registered under pyrexia of unknown origin, and many of these were probably due to malaria.

Education and Propaganda.—Public lantern lectures in English and the vernaculars have been given at Anuradhapura, Trincomalee, Mullaittivu, Mannar, and Erukkulampidi, and lantern lectures and demonstrations at colleges and schools at Kandy and most of the above towns. Additions to the series of lantern slides and posters relative to the subject have been made, and on a few occasions selected slides have been loaned for propaganda purposes. Many thousands of pamphlets and handbills on malaria and mosquitoes have been distributed to towns and villages in various parts of the island and at Anuradhapura and Trincomalee in connection with the anti-malaria campaigns.

A course of lectures and demonstrations on malaria and its control was given during July and August to the Training Class for Sanitary Inspectors held by the Sanitary Branch of the Medical Department.

With a view to encouraging medical officers and others to take up the study of the indigenous anopheline mosquitoes, a paper on the differential characters of the larvæ and adults of the species known to occur in Ceylon has been prepared by the Malariologist. Endeavour has been made to render this article as comprehensive as possible, in order that the student may be relieved of the necessity of consulting textbooks and original papers relating to the subject. This paper will be published in the *Ceylon Journal of Science* (Section D: Medical Science) at an early date, and reprints will be distributed to hospitals and the larger dispensaries.

Larvivorous Fish.—The lines on which larvivorous fish may be utilized as a measure of mosquito control have been indicated in previous reports. The practical value of these fish is more limited than is generally supposed, and it is a mistake to imagine that under natural conditions they are of equal importance in all types of mosquito breeding places, or that they can be used to supplant the more laborious and costly methods of reduction at present adopted. Normally, their beneficial action is much restricted by nature's barriers, and it is doubtful

whether, without human assistance, their presence in natural waters has any notable effect upon the prevalence of mosquitoes. Under artificial conditions—or in mosquito breeding places which are of a temporary nature only—they, however, afford an important measure of control; and it is in this connection that their exploitation in Ceylon should ultimately prove of value. Especially should this be so in those parts of the dry zone where indigenous species do not appear to be abundant, and where innumerable confined and temporary collections of water occur during the rainy season. The formation of nurseries and systematic distribution of these fish at the onset of the monsoon to such situations as rain pools, borrow pits, wells, &c., should form part of any campaign against malaria in these districts.

The nurseries of *Gambusia affinis* (*? Lebistes reticulatus*)—"Millions"—mentioned in earlier reports have been maintained, and except in one case where contamination with oil occurred, have proved very satisfactory. The fish have increased greatly in numbers, the nurseries being well stocked, even although extensive distribution to wells and pools has taken place in certain districts. In some parts of the dry zone, however, it has been found necessary to protect the nurseries with netting or cadjans owing to the prevalence of kingfishers; these birds have frequently been observed feeding on the fish, more especially during the dry season when their ordinary sources of food supply are limited.

The attempts to establish *Haplochilus lineatus* in nurseries have again proved disappointing, and it is probable that the practical value of this fish will be restricted to those regions in which it is indigenous, and where distribution to confined or temporary breeding places of mosquitoes can be made from natural reservoirs.

Malaria Control Measures.—The anti-malaria campaigns at Anuradhapura, Trincomalee, and Mahara Jail—the latter carried out under the supervision of the prison authorities have been maintained during the past year. In these cases of the first two campaigns it is too early to attempt any estimation of results at present, especially since the works involved are still incomplete. The campaign at Mahara prison, however, is naturally a much smaller undertaking than those at the towns, and sufficient time has now elapsed to enable a fairly complete report to be submitted. At Trincomalee considerable headway has been made, but it appears probable that certain major works will be necessary in the near future.

The problem of malaria reduction and control at Anuradhapura is vastly more difficult than at either of the other places, owing chiefly to the extensive cultivation of rice by artificial irrigation within the town limits, to physical conditions resulting from past archæological works, and also to the relatively low degree of sanitation pertaining at the town. Under existing conditions, paddy cultivation in the Anuradhapura District is without doubt conducive to malaria; and when it is considered that approximately six square miles of the town area are devoted to this industry, the magnitude of the problem will be readily appreciated. In fact, it would appear that unless much stricter control of irrigation water can be obtained, and the methods of cultivation (including care of the minor irrigation channels) greatly improved, a definite reduction in the prevalence of the disease will only be attained by prohibiting rice growing in towns and villages situated in this district. There can be no doubt that the apathy, conservatism, and primitive methods of the cultivators are responsible in no small degree for the association of malaria with this industry; but it is certain that if their close and intelligent co-operation could be obtained the danger arising from the fields would be diminished.

Anti-Malaria Campaign, Anuradhapura.—In view of the results obtained from investigations pursued during the preceding year (May, 1922-23) at Anuradhapura it was originally decided to limit anti-malaria measures (commenced in May, 1923) to anti-mosquito works and systematic quinine distribution during the wet season. Other methods of control, such as those directed towards protecting the individual from bites of infected anopheles or of segregating infected persons were rejected as impracticable. The attempt to reduce the numbers of human carriers by quinine administration during the wet season of 1923-24, however, failed owing to the fact that a high percentage of the inhabitants refused to accept the drug regularly.

Anti-mosquito measures were maintained through out the year on the lines indicated in the previous report, but in addition preliminary work on what may be termed a "major" measure (Halpan-ela) was undertaken. The labour force consisted of approximately 40 convicts under the control of guards, and five coolies and a kangany forming an oiling brigade; the work was placed under the immediate supervision of Entomological Assistants G. D. A. Perera and S. L. L. Casiechetty.

Unfortunately it was not possible for a senior member of the staff of this office to be stationed at Anuradhapura, and the direction and supervision of the campaign had to be performed from Colombo. In the latter respect, however, the Chairman of the Local Board has given valuable aid, and had personally inspected the work of the brigades on numerous occasions. The cost of the campaign has so far been borne almost entirely by the local authorities, who voted Rs. 1,500 for the period May-December, 1923, and Rs. 3,000 for the year 1924. Much greater assistance financially would have been necessary, but for the fortunate circumstance of prison labour being available. During January to April the execution of minor initial measures and maintenance works was continued in the central area of the town. At the end of the latter month preliminary work on the northern portion (section 4) of Halpan-ela was commenced, and was continued until October. Subsequent to October the work included clearing, filling, and drainage measures in sections 5 and 6; and pumping dry, cleaning and introducing larvivorous fish into wells in the bazaar area.

Colonial Medical Reports.—No. 193.—Ceylon (*continued*).

Oiling as a temporary measure of control of pools and swamps which could not be eliminated or permanently improved at the time was continued throughout the year over an area with radius 1½ miles from the centre of the town. This area extended considerably beyond that portion of the town where permanent measures were in progress. The work was carried out by the special brigade mentioned above; the coolies were supplied with spraying machines, and applied oil (kerosine 1 part, fuel oil 4 parts) once each week to all recognized breeding places of anopheles.

The work performed during the year may be approximately summarized as follows: Extent of jungle and low shrub cleared, 51 acres; number of pools (including pokunas) cleared and trained, 80; content of pits, swamps, &c., filled, 278,904 cubic feet; content of earth drains and irrigation channels cleared, trained, and regraded, 350,842 cubic feet; content of new drains cut, 12,968 cubic feet; culverts reopened, 26; wells cleaned and stocked with larvivorous fish, 49. Average number of situations oiled per month: Dry season (April to September), 864; wet season (October to March), 1,688.

As stated in the report for 1923, two important problems—the reconstruction of Halpan-ela and improvement of the general drainage system, and the control of mosquito breeding in wells—remained to be dealt with in the central portion of the town. Some progress in both of these has been made during the past year, and it is hoped that by the end of 1925 the work of Halpan-ela and the introduction of larvivorous fish into wells will be completed. There will yet remain, however, the questions of reorganization and improvement of the general drainage system. During the year the local authorities have constructed several cement drains in the neighbourhood of the bazaar, but such improvements are restricted to a relatively small area, and will have little or no effect on the incidence of the disease generally. It is essential that the entire drainage system be reorganized in order that surface water during the north-east monsoon and leakage or waste from irrigation channels and paddy fields may be removed as rapidly as possible. The utilization of drains as irrigation channels by cultivators should be prohibited. Following a report to the local authorities on the condition of Halpan-ela and its relation to malaria, a conference was held at Anuradhapura on February 13, 1924. Those present were the Government Agent; the Provincial Engineer, North-Central Province; the representative of the Divisional Irrigation Engineer, Northern Division; the Secretary, Local Board; and the Malariologist. A detailed inspection of the whole course of the ela was made, and it was resolved that a survey be undertaken and levels determined at an early date. This work was commenced in April and completed in September; it was performed by the Survey and Irrigation Departments respectively. The Divisional Irrigation Engineer then proposed a scheme for reconstruction of the ela and submitted estimates of the cost. There are no apparent difficulties from the engineering point of view, and it is proposed to drain the ela to the river in three tracts by subsidiary channels. With a view to reducing expenditure under this item as much as possible, it has been arranged for the greater part of the work to be performed by prison labour. The work will be commenced in the southern portion of the ela early in 1925, and will be executed under the direction of the Divisional Irrigation Engineer.

Pending the completion of the survey and determination of levels, preliminary work, consisting chiefly of canalization and clearing, was undertaken in the northern portion of the ela from April to October. The stream in this area was in an exceptionally bad state, and it was therefore considered advisable to alleviate the existing conditions as much as possible before the advent of the wet season. This work was carried out over approximately 1½ miles of the ela, the bed being recut and built to an average width of 13 feet and an average depth of 2½ feet; nearly 210,000 cubic feet of earth were removed and employed in rebuilding the banks or filling adjoining swamps and low-lying areas. Several new drains (3,650 cubic feet) were cut and connected with the ela.

An additional nursery for larvivorous fish was constructed in April, and was connected by pipes with one of the larger pokunas in order to ensure a constant supply of water. This nursery was protected by fencing and netting and stocked with "millions"—partly from the original nursery and partly from the nursery at Jaffna.

The particular objects identified with the administration of quinine at Anuradhapura and the methods adopted to ensure its systematic distribution throughout the town were given in the previous report. The work was under the control of the Provincial Surgeon, North-Central Province, and was maintained from October 17, 1923, to March 31, 1924.

Owing to the high spleen and parasite rates (see previous report) found by random sampling of the inhabitants, it was considered impracticable to restrict quinine administration solely to those in whom definite evidence of malaria infection could be obtained. Such restriction would have involved an enormous number of blood examinations, which could not have been undertaken by this office without the assistance of several trained microscopists. It was decided, therefore, to afford every inhabitant the opportunity of regular treatment during the period in question.

PARASITE RATES, TRINCOMALEE, JUNE, 1924.

Of the total films (132) in which malaria parasites were observed, *P. vivax* (benign tertian malaria) occurred in 74·3 per cent., *P. malariæ* (quartan malaria) in 18·2 per cent., and *P. falciparum* (subtertian or malignant malaria) in 7·5 per cent. The parasite of quartan malaria was more frequently observed in children (23·1 per cent.) than in adults (12·6 per cent.), while that of subtertian malaria

occurred more often in the latter (children 5·7 per cent., adults 9·5 per cent.). The average parasite rate (14·6) in children was higher than that (9·3) found in September of the previous year, when 224 films were examined.

The quantitative investigations undertaken with a view to estimating the prevalence of anopheles referred to above are not yet completed. They were restricted largely to the larval stage of the various species concerned, since it is contended that the closer limitations of the larval environment and greater uniformity in larval habits ensure stricter accuracy of measurement than can be obtained by work with adult mosquitoes. The work was continued throughout the greater part of the year, and included the careful examination each month of various types of potential breeding places situated within the town.

Observations on the breeding of anopheles in the Admiralty area and Maniaveli were performed in January and from March to October. These areas adjoin the southern limits of the town and are extensive; they include a relatively large open marshy tract and higher lands thickly covered with scrub jungle, in which are situated numerous abandoned quarry and borrow pits. The low-lying ground in the Admiralty area contains a large number of potential breeding places of anopheles, but is to some extent subjected to tidal flushing; the water is usually salt or brackish, but during the rains become sufficiently diluted in certain situations to support the larvæ of several species. Forty situations of various types were selected for examination in this area throughout the period mentioned. In January and March the anopheles found in order of larval prevalence were *A. subpictus* (Grassi), *A. funestus* var. *listoni*, *A. culicifacies*, *A. barbirostris*, and *A. hyrcanus*, but at no time were larvæ very numerous. From April onwards the number of water collections rapidly diminished, and the degree of salinity in many of those remaining increased considerably. No larvæ of anopheles were found during the period April to October.

It would appear that less danger is to be apprehended from the actual water-logged area than from the Maniaveli quarry pits, some of which are situated within a quarter mile of Admiralty House. These pits provide very favourable breeding places for anophelines, being protected by a thick belt of low jungle and capable of retaining water for long periods. Examinations made from April to August, when most of the pits contained water, showed that prolific breeding occurred in this area, and that larvæ of *A. funestus* var. *listoni*, *A. subpictus*, and *A. culicifacies* were most prevalent. Upwards of 10 of these pits have at present been located, and fresh ones are still being formed. They are situated sufficiently near the town, however, to constitute a source of danger, and their elimination will be necessary; at present no permanent measures have been introduced in this area, control being maintained by systematic oiling.

The importance of wells as breeding places of anophelines at Trincomalee was indicated in the previous report. Nearly 800 wells are present in the town, and of these approximately 80 per cent. are constructed of stone and cement and provided with parapets. They vary considerably in depth, but many (about 40 per cent.) dry out or contain little water during the last two or three months of the hot season; in the latter condition they are not used, the water supplies being obtained from such wells as remain serviceable. Comparative observations on used and disused wells were commenced in July and continued throughout the remaining months of the dry season. Forty used and thirty disused wells which had not been stocked with larvivorous fish were selected for examination.

Breeding of Anopheles in Wells, Trincomalee.

Not only were anopheles larvæ found almost twice as often in wells which were temporarily disused, but the larvæ were far more abundant in such wells. *A. funestus* var. *listoni* was the predominant species, but *A. culicifacies*, *A. subpictus*, *A. jamesi*, *A. fuliginosus*, and *A. hyrcanus* also occurred; the three last named anopheles were, however, only found in disused wells.

The control of mosquito breeding in wells at Trincomalee, as in many other towns in the island, is a problem of considerable importance and magnitude in relation to malaria reduction. The larvæ of dangerous malaria-carrying species, such as *A. funestus* var *listoni*, *A. culicifacies*, and, in the hill-country, *A. maculatus*, are commonly found in them; and in the dry zone they act as permanent larval reservoirs during the pre-monsoon period, when conditions are distinctly adverse to mosquito propagation. Until such time as pipe-borne water supplies can be introduced, it would appear that the most promising, and certainly the most economical, measure of control will be by means of the larvivorous fish, "millions." The treatment of wells by other methods, such as sealing and instituting pumps, screening, or oiling, appears to be impracticable either on grounds of expense or because such methods would lead to opposition or incorrect usage on the part of the public. There can be little doubt, however, that the number of wells present in most towns is excessive, and that many could be abolished without detriment to the inhabitants. Rigorous restrictions must be placed upon the construction of private wells in towns, and all such wells not in constant use should be condemned and closed by the owner without delay. The formation of unbuilt or "earth" wells—no matter for what purpose they are designed—should be prohibited, and those at present existing should everywhere be eliminated. The strict enforcement of such measures in conjunction with the extended use of fish would go far towards solving the problem.

The inquiry into the incidence of malaria among the coolies employed on the Admiralty Works at China Bay was instituted chiefly with a view to determining the possibilities of malaria importation from the camp during the north-east monsoon

period. The site of the works is situated approximately ten miles by road from Trincomalee in a severely malarious district. At the time of the investigation work had been in progress for some months, and over 1,000 men were employed. Of these, however, approximately 400 only lived on the site, the remainder being recruited mainly from Trincomalee and the surrounding villages. Large numbers of the latter class returned to their homes each evening, thus ensuring close connection between the camp and the town. Spleen and blood examinations of samples of the resident coolies were made in October; 56 of 362 (15·5 per cent.) coolies showed splenic enlargement, and 6 of 158 (3·7 per cent.) malaria parasites in the blood. The spleen rates ranged in the different classes of men from 0 to 33·3 per cent., but it should be noted that the examinations were made at the end of the dry season, and that the majority of those examined had only been present in the camp for a period of two or three months. At this time mosquitoes of all kinds were very scanty, and their breeding places reduced to a minimum. The results, however, indicated that the composition of the resident labour force in regard to malaria infection was of a varied nature, and that considerable numbers of susceptible coolies were present. This fact, when associated with conditions existing at the camp and its immediate vicinity, could only be regarded as favourable to the production of an epidemic at some future date, when a more or less severe reaction upon the town might be expected. Recommendations were, therefore, made to the authorities, who instituted precautionary measures within their area.

Anti-Malaria Campaign, Mahara Prison.—As stated in the report for 1922, malaria control measures were instituted at Mahara towards the end of that year, following a severe epidemic among the prisoners and staff during June to October. The measures recommended were carried out by the prison authorities, and by the Harbour Engineer's and Public Works Departments in the areas under their administrations.

The prison is situated in the Western Province a few miles north-east of Colombo; it has been in existence for several years, but originally was not built with a view to permanency. Many of the buildings are of a purely temporary character, consisting of mud and wattle walls and cadjan roofs; they are poor and ill-ventilated, and in many cases form most attractive types of shelters—for resting and feeding purposes—for mosquitoes. Since 1915 the establishment has consisted of two jails, the old jail and the portable jail, the latter having been transported from Mankulam (in the Northern Province), and re-erected in the quarry included within the prison area. The water supply is pipe-borne, being pumped from reservoirs at Ragama. Two quarries, from which metal for the harbour and roads is obtained by convict labour, are closely associated with the prison; the larger and more important is that referred to above, the smaller is situated outside the jail premises, at a distance of approximately 200 yards from the portable jail. The lands surrounding the prison are for the most part under cultivation, consisting of coconut plantations, paddy fields and native gardens. The climate is hot and moist, similar to that of Colombo, the annual average rainfall is slightly over 90 in., the wettest months being April to June and September to November, at the onset of the south-west and north-east monsoons respectively.

Although the prison is situated in a district of low malarial endemicity, it has for years past maintained an unenviable reputation in regard to the prevalence of malaria. The annual reports for recent years of the resident medical officers contain particular reference to this disease, the increased severity of which it is maintained dates from the establishment of the portable jail. Attempts to control the disease were made in 1915, 1916, 1918 and 1919, but the measures adopted (quinine prophylaxis and occasional oiling of pools), although affording a temporary measure of relief, were not such as to confer permanent improvement.

Investigations made with a view to instituting a definite campaign against malaria were commenced during the epidemic in September, 1922. At this time very numerous cases were applying daily for treatment, and hospital accommodation was possible only by the conversion of prisoners' wards. The epidemic was by no means confined to the convicts, and members of the staff and their families resident at, or in the immediate vicinity of, the jail also suffered severely.

The forms of malaria present at the time of the epidemic, and their relative prevalence as determined from films (31) in which parasites were observed, were: benign tertian (*Plasmodium vivax*) 51·5 per cent., subtertian or malignant (*P. falciparum*) 48·5 per cent. No parasites of quartan malaria were seen. Subtertian malaria was distinctly more prevalent than has been observed elsewhere, extended investigations having shown it to be responsible for an average of approximately 10 per cent. only of malarial infections.

A mosquito survey of the jail and its immediate neighbourhood showed that breeding places of several species of anopheles were present. Adult anopheles, however, were not abundant at any time during the investigation, and although careful search was made in the early mornings and evenings, very few specimens were obtained. Dissections of the latter, made with a view to definitely incriminating the active malaria-carrying species, gave negative results. Larvæ or adults of the following species were found in the course of the survey: *Anopheles barbirostris*, *A. culicifacies*, *A. fuliginosus*, *A. funestus* var. *listoni*, *A. hyrcanus*, *A. jamesi*, *A. subpictus* and *A. subpictus* var. *vagus*. Breeding places of all these anophelines were found both within the prison premises and in the surrounding neighbourhood, but those of *A. culicifacies* and *A. listoni* were much more numerous in the former area. This was particularly the case with *A. culicifacies*, the larvæ of which were found to a very limited extent outside the jail

boundaries. In this connection it is of interest to note that both *A. culicifacies* and *A. listoni* are relatively uncommon in the district generally, and that the former—which becomes much more plentiful in the drier districts further north—appears to be very restricted or local in its distribution in this region.

The remaining species of anopheles, with the exception of *A. fuliginosus*, which was found in only one situation (within the quarry), appeared to be plentiful, their larvæ being numerous in adjoining paddy fields, road drains overgrown with vegetation, coconut trenches, &c. The results of the survey appeared to indicate that anti-mosquito measures could be largely confined to the jail premises and the quarries, and that except in one area little was required elsewhere. The chief breeding places of the two important species mentioned above were (1) the ella and quarry drains; (2) wells and bathing pools; (3) small pools in the irregular surface at the foot of the working face of the quarry; and (4) newly formed trenches in the coconut plantation adjoining the southern boundary of the prison. The stream or ella flowed along the eastern boundary of the prison and passed within a few yards of the portable jail; the bed was in places composed of rock, containing numerous pot-holes, and at intervals partially blocked by masses of stone and weeds, or considerably narrowed by infringement of the banks; in many places also the sides were built of pieces of rock, the interstices between which formed excellent larval shelters. The quarry drains were badly graded, and, except during heavy rain, contained many small pools; they were in poor condition, and were insufficient to eliminate seepage water from the face of the quarry. It was, moreover, a common practice of the convicts to construct temporary dams in these drains in order to form pools in which to perform their ablutions, and to soak their baskets preparatory to repair. Wells and bathing pools were very numerous, particularly within the quarries; these pools, which were shallow and faced with pieces of rock, provided with very favourable breeding places for *culicifacies*.

The pools at the foot of the working face of the quarry were prolific breeding places of both *A. culicifacies* and *A. subpictus*. As the face of the quarry receded, the irregular surface at its base produced by blasting and other operations was filled and levelled, but such measures could not be carried out in the actual working area, and therefore numerous small pools were invariably present. Larvæ of *A. culicifacies* and *A. subpictus* were abundant in the newly cut trenches in the adjoining coconut estate, these being the only breeding places of the former species found outside the quarries; old trenches overgrown with vegetation were present in considerable numbers in the surrounding neighbourhood, but many were used for soakage purposes and were negative, while those in which the water was not polluted were only found to harbour larvæ of *A. barbirostris*, *A. hyrcanus*, *A. jamesi* and occasionally *A. subpictus*.

The results of these investigations indicated that the main factors responsible for the severe incidence of malaria at the prison and its almost complete restriction to so limited an area were:

(1) The continued presence and close association of a large body of convicts drawn from all parts of the island, and invariably including a number of infected persons[1].

(2) The presence in the immediate vicinity of numerous collections of water favourable as breeding places of two efficient insect carriers of the disease—*A. culicifacies* and *A. funestus* var. *listoni*—and the relative scarcity of these two anophelines, particularly the former, elsewhere.

(3) The presence of an abundance of food supply—the blood of persons living in the jail—for the anopheline mosquitoes close to their chief breeding places, and the relatively sparse population and scattered distribution of dwellings in the surrounding districts.

A report with recommendations for control and prevention was submitted to Government at the end of September, 1922, and was shortly followed by a detailed inspection of the prison area. The officers present at the inspection included the Principal Civil Medical Officer, the Director of Public Works, the Inspector-General of Prisons, the Sanitary Commissioner, the Deputy Harbour Engineer, and the Malariologist. As a result of this inspection a report, supporting and, in certain instances, extending the recommendations previously made by the Malariologist, was forwarded to Government.

In view of the results of the investigations, and of the difficulty of determining to what extent it would be possible to deal effectively with breeding places of anopheles on private lands in the vicinity of the jail, it was considered advisable to await the effects of anti-malaria measures in the prison area before attempting any works outside that area. The measures recommended were, therefore, largely restricted to the jail premises and the adjoining quarries; they may be summarized as follows:

(1) *Improvement of Buildings.*—Structural alterations and additions to the staff quarters or preferably the erection of entirely new quarters of a superior type sufficient to house the entire staff prevent any of the subordinate officers having recourse to existing miserable dwellings in the near vicinity.

The extension and improvement of the hospital accommodation for both the staff and the convicts, including the provision of mosquito-proof wards for acute cases, and the erection of two additional wards of fifty beds each for convalescent cases. Alternatively, in view of the expense connected with such improvements, it was recommended that the building of the proposed new prison at Ragama be commenced with the least possible delay.

[1] The Resident Medical Officer reports that of 847 prisoners admitted to the jail in 1924, 595 (70·2 per cent.) had a previous history of malaria.

Colonial Medical Reports.—No. 193.—Ceylon *(continued).*

(2) *Quinine Administration.*— Arrangements to be made by the prison authorities for the compulsory curative and preventive treatment of prisoners and members of the staff and their families, especially with a view to sterilizing existing human carriers and reducing the number of relapses and new infections. Such treatment to be applied also to all new arrivals at the prison in whom evidence or history of infection with malaria was obtained. These measures to be continued until anti-mosquito measures were completed, or until such time as it was considered advisable to modify or suspend them.

(3) *Transference of Staff.*—The transference to non-malarious stations of all officers—particularly if married—in whom symptoms of malarial cachexia or severe malarial infection were present, after they, and if necessary their families, had undergone the above treatment for a period of not less than one month.

(4) *Reduction of Labour.*—The daily task of all prisoners engaged on work in the quarries, and undergoing the above treatment, to be reduced until such treatment was completed.

(5) *Anti-Mosquito Work.*—The inauguration of suitable measures directed primarily against the species *A. culicifacies* and *A. funestus* var. *listoni*, to reduce the number of their breeding places or to render such places unfavourable for breeding purposes.

The measures proposed under heads (2) to (5) above were instituted without delay. The systematic administration of quinine was under the control of the Resident Medical Officer, and anti-mosquito works were carried out by gangs of prisoners under the direction and supervision of the Harbour Engineer's and Public Works Departments.

All superfluous bathing pools and wells were immediately closed, and those remaining stocked with larvivorous fish. These fish were also introduced into a rock-built tank—in which culicine larvæ were abundant— with a view to forming a nursery and ensuring future supplies. The general drainage system of the main quarry was much improved, and existing drains were regraded and lined with cement; the practice of damming these channels was prohibited, and all pools formed in this way eliminated. Depressions containing, or liable to contain, water at the base of the working face of the quarry were temporarily filled with sand or oiled once each week. Improvement of the bed of the stream mentioned above presented the chief obstacle in connection with anti-mosquito measures. It was originally recommended that the bed be recut throughout its course in the jail premises and for a distance of one-half mile on each side of the boundaries. This, however, was not considered feasible in its entirety, and less laborious and expensive measures were provisionally adopted. Briefly, the stream was rebuilt and regraded everywhere, except in those portions of its lower course where such work entailed cutting through solid rock: the banks were constructed of pieces of rock, and all interstices filled with cement to a height of several inches above the level of the water. A dam provided with a sluice was then erected a short distance above the rock-bound situations in order that every few days, when sufficient head of water had accumulated in the upper portion of the stream, strong flushing could be obtained. Repeated observations made subsequent to the erection of the dam indicated that this method of treating the stream was satisfactory, provided the sides and channel were kept free from weeds and debris. Indigenous larvivorous fish (*Haplochilus lineatus* and *Rasbora daniconius*) were numerous, and in the area above the dam—where prior to flushing an unbroken sheet of water existed—were able to exert their beneficial action to its fullest extent. Examinations made both above and below the dam showed that under these conditions anopheles larvæ were extremely scanty, and on several occasions none was found within approximately 200 yards of the boundaries.

In addition to the anti-mosquito measures outlined above, a permanent brigade (consisting of ten to twelve convicts, was formed for maintaining such measures in good condition. The duties of this brigade, which was under the control of the prison superintendent, included the regular clearing, flushing, and, if necessary, repair of the ella and quarry drains, the temporary filling and weekly oiling of pools near the face of the quarry, the removal of rank and low-growing vegetation, the collection and disposal of old tins, coconut husks, &c., and similar works. This party also extended their activities to the care of drains on private lands adjoining the prison.

Larvivorous fish were introduced into the coconut trenches mentioned above, but no further action was possible. These trenches are now overgrown with vegetation, and larvæ of *A. culicifacies* have not been found in them for more than one year. At an early date, however, this plantation was thoroughly cleared and numerous pits and holes obliterated. This was done mainly as a demonstration to the neighbouring landowners to indicate the lines on which co-operation was required. Propaganda work performed and breeding places of anopheles demonstrated, but although considerable interest was shown at the time, little or no response to the appeals has been made.

Cholera.—17 cases of cholera with 14 deaths were reported during the year. Of these, 1 occurred in Colombo town, 1 in the port of Colombo, 1 in the North-Western Province, 4 in the Central Province, 1 in Sabaragamuwa, and 9 in Uva, where there was an outbreak in 1919-20. There were no cases during 1921, 1922 and 1923.

Small-pox.—There were 45 cases with 9 deaths, as against 240 cases with 35 deaths the previous year. Of the cases reported during the year, 4 cases were landed in Colombo from steamers, 4 cases occurred in Colombo town, 8 cases were admitted to the Infectious Diseases Hospital, Colombo, from the neighbouring villages, 1 occurred in the North-Western Province, 1 in Sabaragamuwa, 1 in the

Central Province, and 26 cases with 5 deaths in the Northern Province, where there was an epidemic in the Jaffna Peninsula in the last quarter of the year.

Vaccinations.—The total number of primary vaccinations performed during the year was 128,591, of these 123,009 were successful and 2,775 were failures. In 8,465 cases the results were not determined. Vaccination is carried on throughout the year by trained male and female vaccinators, the former vaccinate in the towns and villages and estates periodically according to annual programmes of vaccination, and the latter itinerate in the towns and villages to vaccinate Muslim women and children.

Enteric Fever.—The total number of cases treated in Government hospitals during the year was 1,600 with a death-rate of 25·5 per cent., as against 921 cases with a death-rate of 29·31 per cent. in 1923. The increase in hospital admissions is partly due to the activities of the Sanitary Branch in discovering cases and recommending hospital admission. The number of hospital admissions again does not indicate the actual prevalence of the disease, for some cases reported as deaths from pyrexia are due to enteric fever, although the bulk are probably due to malaria. The Registrar-General's returns show that 816 deaths from enteric fever and 17,697 deaths from pyrexia of unknown origin were registered during the year, and undoubtedly some of the latter should have been included in the former. The corresponding figures in his returns for the previous year were 597 and 23,328 respectively. Patients are usually taken to the hospitals for admission in late stages of the disease, and the mortality rate of these cases is therefore high.

Diphtheria.—Nineteen cases with seven deaths were recorded during the year, as against 15 cases with 6 deaths during the previous year. Of the former, 8 cases with 2 deaths and 1 case with 1 death were reported from the Infectious Diseases Hospital, Colombo, and the General Hospital, Colombo, respectively. Three cases with 1 death from the Western Province, 6 cases with 2 deaths from the Central Province, and 1 case with 1 death from the Northern Province.

Influenza.—A mild form of influenza prevailed in all the provinces at different periods of the year; 3,888 cases were treated in Government hospitals with 115 deaths, a mortality rate of only 2·9 per cent. The corresponding figures for the previous year were 4,443, 162, and 3·64 per cent. respectively.

30,719 cases were treated at dispensaries during the year, against 23,372 cases in 1923.

Of the total number of cases treated during the year, 5,112 out-patients and 1,233 in-patients were treated in the Western Province, 15,544 and 1,208, respectively, in the Central Province.

Dysentery.—Cases of dysentery were reported from all the provinces during the year. The number treated in Government hospitals was 6,165, with 1,217 deaths, as against 5,884 and 993 respectively the previous year. Of the in-patients treated during the year, 1,123 cases with 112 deaths were reported from the Western Province, 1,022 cases with 237 deaths from the Province of Sabaragamuwa, and 1,335 cases with 423 deaths from the Central Province.

Drinking water obtained from shallow, unprotected wells is the most common source of infection, and usually heavy rains with consequent flooding causes pollution of the villagers' water supply. 4,080 deaths from dysentery were registered by the Registrar-General's Department during 1924, as against 3,326 in 1923.

Cancer and Sarcoma.—The number of patients admitted to the various hospitals during the year with malignant growths was 434 with 57 deaths, as compared with 443 cases with 59 deaths in 1923. The total number of deaths from "cancer of malignant diseases" reported by the Registrar-General was 473, as against 433 registered in 1923. 28 cases of cancer were admitted to the Lady Havelock Hospital for Women, Colombo, during the year under review: of the cervix uteri 23, breast 2, bowel 2 and glands of neck 1 (secondary).

The admissions during the previous year were cancer of the cervix uteri 17, of the uterus 4, ovary 1, breast 2, liver 1, bowel 1, vulva 2, vagina 1, rectum 1, and anus 1. The average age was 38·96 in 1924, 41·16 in 1923.

Ankylostomiasis.—153,488 cases were treated at dispensaries during the year.

These figures refer to cases of ankylostomiasis as the primary disease; but owing to the almost universal infection of all hospital and dispensary patients, mass treatment for this disease was carried out during the year at dispensaries and hospitals, and a large number of persons received necessary treatment.

Tubercular Diseases of the Lungs.—The number of hospital cases treated during the year was 3,657 with 860 deaths, as against 4,099 cases with 990 deaths in 1923.

Leprosy.—Two asylums are maintained in the island for the segregation of lepers under the Lepers Ordinance, No. 4 of 1901—at Hendala in the Western Province and the Island of Mantivu, in the Eastern Province. They are nursed by religious sisters with the help of male and female attendants at both asylums.

There were 114 lepers at Mantivu island on December 31, 1923. 48 were admitted during the year, 12 died, 31 were discharged or absconded, and 119 remained on December 31, 1924. Of the admissions, 14 were new cases, 31 readmissions and 3 absconders from the Hendala Asylum. The daily average in the asylum during the year was 112·95 per cent., and the percentage of deaths 7·41.

The report of the Medical Superintendent in charge of the asylum at Hendala gives the following figures for the year under review: Remained on December 31, 1923, 516; admitted during 1924, 135; discharged, 77; died, 51; remained on December 31, 1924, 523.

Of the 135 admissions, 110 were new cases; 17 of these, 9 were of the tubercular type, 29 of the

anæsthetic type, and 72 of the mixed type. The new admissions were from the following provinces: Western 62, Central 12, Southern 14, Northern 6, North-Western 3, Sabaragamuwa 6, and Uva 7.

The Medical Superintendent reports 146 lepers were treated during the year with E.C.C.O., 3 of these were discharged cured in October last, many of the younger subjects under treatment who have been regular have shown marked improvement, and if this regularity is maintained still better results can be expected in the near future.

There has been steady progress in the early cases under this treatment, and there are a number of patients now in the asylum whose discharge as cured will soon have to be considered. The majority are, however, in the last stage of the disease and of the advanced crippled nerve type, and these can only hope for some relief, some improvement in their general health from this treatment.

Parangi (Frambæsia, or Yaws).—The number of hospital admissions was 6,149 with 18 deaths, as against 9,748 admissions with 32 deaths in 1923. The decrease in the number of admissions to hospitals during the year was due to intensive campaigns by seven itinerating medical officers in the Central, Southern, Eastern, North-Western, North-Central, Uva and Sabaragamuwa Provinces, and the treatment of a large number of out-patients brought in by headmen and voluntarily seeking treatment at dispensaries and the out-patient departments of hospitals. The seven itinerating medical officers treated a total number of 17,852 cases, and a large number of these patients attended a second and a third time, and 33,052 injections were given during the campaign in 1924, as against 16,815 cases and 30,139 injections in 1923.

Plague.—There were 153 cases (Colombo town 148, Kalutara 1, Talaimannar 1, Peliyagoda, near Colombo, 1, and Talawakele bazaar 2) during the year with 145 deaths, as against 232 cases with 211 deaths in 1923, 160 cases with 150 deaths in 1922, 187 cases with 171 deaths in 1921, and 369 cases with 316 deaths in 1920. Of the 153 cases reported, 59 males and 12 females were admitted to the Infectious Diseases Hospital, Colombo, 62 were bubonic, 7 septicæmic, and 2 pneumonic. The septicæmic and the pneumonic cases proved fatal, and of the total number of cases treated during the year 19·2 per cent. recovered, as against 15·68 per cent. recovered the previous year.

Port Health Precautions.—During the year 2,584 British and foreign steamers and 297 native sailing vessels called at the Port of Colombo and were inspected, as against 2,363 steamers and 285 sailing craft in 1923.

Six steamers arrived infected and were placed in strict quarantine; of these, 3 arrived with small-pox, 1 with cholera, 1 with cerebrospinal fever and 1 with typhus. All the cases were landed and sent to the Infectious Diseases Hospital. 7 cases of chicken-pox were landed during the year.

Of the samples of water taken from the water boats and sent for analysis only two were condemned, and necessary action immediately taken to have the boats cleaned and cement-washed.

The number vaccinated during the year was 5,963, mostly arrivals foom India *viâ* Tuticorin.

Disinfection of 152,934 persons and their clothing was carried out at the port disinfecting station.

At the port venereal clinic for seamen 61 cases of syphilis were treated by intravenous injections in 1924.

Medical Inspection of Schools.—The routine inspections of all the more important schools were carried out on the same lines as in previous years, individual pupils being examined in detail for any chronic disabling conditions. The number of schools examined was 72 boys' and 81 boys' schools, the total number of children being 3,570 boys and 5,209 girls. As in previous years, the most common disabilities in the children of urban schools were dental disease and defective vision, and in rural schools infection by hookworm and malaria. In the former case the degree of visual defect was rarely such as to interfere with the progress of the child in school, although in a few instances it exceeded 6/12 D. Less numerous and, yet perhaps, more serious among eye diseases met with, were cases of chronic follicular catarrh, due largely to imperfect treatment of acute ophthalmia. These cases undoubtedly constitute the sources from which, under favourable conditions, serious epidemics of acute disease occur. Dental disease is becoming more numerous among school children, especially of urban areas; a large number of the cases have advanced to such a stage that no conservative treatment can be adopted; younger children go about with retained milk teeth on account of the difficulty of obtaining relief; many cases with early caries are frequently absent from school on account of attacks of pain. Dental treatment under existing conditions in Colombo and the outstations is beyond the means of the average parent; an extraction or a single filling costs as much as Rs. 5, and medical inspection of schools will never realize its full results until better facilities for treatment are provided by the State. The urgency exists only in the larger towns, and as soon as a central institution in Colombo is opened, it would be possible to arrange for occasional visits of a travelling clinic to smaller towns.

The problem of malaria among school children is part of the problem as it affects the whole island. Side by side with the development of the sanitary part of the campaign, strong educational efforts must be made to secure the right response from the public. It is hardly likely that the anopheles mosquito will ever be exterminated from the island, but it has been declared that "given sufficient quinine and a public ready to co-operate with the health authority, malaria may be got rid of in any part of the world." The suggestion here, of course, is that all human malaria carriers can be sterilized, rendering the mosquito harmless in its relation to the disease. This implies that all persons infected with malaria should be treated with quinine until the sufferer's blood is declared

parasite-free. A radical measure of this kind is bound to meet with considerable opposition unless the ground is prepared in the schools. It has been possible to control the epidemic incidence of small-pox by compulsory vaccination of all children before admission to school; in a similar manner some attempt at thorough treatment of all malaria carriers will have to be carried out in some of the more important Government schools situated in malarial districts.

Regarding hookworm, with the facilities now available, both for examination and treatment, the severity of infection can be effectively controlled. Recently a sum of money was voted by Government for the erection of school latrines, and a plan providing a compartment for a bucket and an ablution chamber has been approved.

The propaganda of the hookworm campaign and the operations of the directors have popularized the specific treatment in the schools, and it only remains now to ensure that the schools are regularly visited and the measures to prevent reinfection are perfected.

An unusual number of cases of itch was noticed in the Matara schools, and the infection has probably been carried to these schools from the neighbouring dry districts of Tangalla and Hambantota; lack of sufficient water for bathing purposes is undoubtedly one of the predisposing causes of the spread of this disease, but that factor hardly operates in Matara, where no doubt the ignorance of its parasitic and contagious nature favours its spread.

During the year a number of vernacular schools in the Western and Southern Provinces were visited in order to ascertain their sanitary condition and the kind of instruction that is given in hygiene. The buildings are mostly of the single-hall type with a low wall, some of them are paved and cemented; the old-fashioned long benches are everywhere in use, and in some the accommodation was seriously taxed; the sanitary conveniences consisted of a cesspit only in some of the schools.

Two periods a week are set apart for a class lesson on hygiene, and some elementary books are prescribed for study, but these lessons in several schools were lacking in detail and practical value, and in some instances the teacher was obviously ill-equipped for the task himself. Instruction in hygiene for children in these schools should be directed towards the cultivation of hygienic habits and demonstrations in certain sanitary methods. It is the development of the "Sanitary Conscience" so neglected in these children and so vital to the sanitary progress of the country that should be promoted. The more backward the locality in which a school is situated the greater the care that should be paid to the sanitary details of the school and its equipment. The site, the locality, and the building, with its drainage, water supply and sanitary conveniences should be such as to afford a permanent object-lesson in essentials; the cleanliness, repair, and equipment should always be above criticism. Such a standard will, however, not be attained until specific conditions are laid down as to what is the minimum required before registration. The Code has laid down certain conditions relating to school buildings and their sanitary condition, which have to be complied with before registration; but they should be further amplified by insisting on provision being made for play-ground accommodation, water supply and latrines, and these should be of a type that has the approval of the education department.

The work of the treatment clinics has continued during the year, the total number of cases at the Eye Hospital being 268 and at the Anti-Tuberculosis Institute 215. These children paid a total number of 724 and 713 visits, respectively, during the year. Of the 268 children treated at the Eye Hospital 140 were eye cases, 81 throat cases, 39 ear cases, and 8 nose cases.

The school nurse reports a distinct improvement in the health of the school children and that parents are less averse to treatment by minor operative measures. In some cases they will travel many miles to see the lady doctor at the school clinic.

In all some 8,779 children were medically examined and defects or ailments found in 1,963 of them, as against 8,588 and 2,158, respectively, the previous year.

Scientific Section.

Government Bacteriological and Pasteur Institutes.—Report of the Director, Dr. Lucius Nicholls, for the year 1924:—

A.—Bacteriological Institute.

Routine Work.—The number of specimens examined during the year was 8,228. The fees which were received for the examination of specimens, not sent from Government institutions, amounted to Rs. 5,972, and were credited to revenue.

The Bacteriological Examination of Water.—Samples of 83 different sources were examined during the year.

On several occasions during past years a sample has been received at this laboratory and has been of excellent quality, and at a later date another sample has been received from the same source and has been condemned as unfit for human consumption.

Because such results as these have been considered extraordinary by the senders of samples, it appears that misapprehensions and hazy ideas exist as to the meaning and value of bacteriological and chemical examinations of water for drinking purposes.

It should be understood that the result of the examination of one or more samples from any water supply is only of value when it is considered in conjunction with the thorough inspection of the source of the supply, such as the catchment area, by a sanitary expert.

Colonial Medical Reports.—No. 193.—Ceylon (*continued*).

The contamination of the water supplies is usually intermittent, and even when half a dozen or more samples from a supply have been found to be chemically or bacteriologically pure, very little reliance can be placed upon this unless the catchment area of the supply is properly conserved.

A water may be bacteriologically pure for 99 days, and on the 100th day excessive rains or some other adventitious occurrence may cause contamination of the water supply. The following is a good example of this:—

The water supply of Diyatalawa was examined on two occasions and found to be bacteriologically pure. After heavy rains the same supply was found to be teeming with "fæcal" bacteria. It was discovered that during these rains the drainage from the coolie lines and a tea estate was washed into the supply. In other words, the catchment area was not properly conserved, and yet, during dry weather, the water percolated sufficiently through the earth for natural filtration to purify it. In this case the military authorities had relied on the early chemical and bacteriological examinations and were misled as to the purity of the water.

It is desirable, especially in the case of expensive town installations of water supplies, that the bacteriologist should visit the catchment areas with the engineer and collect the samples himself. It is important that the bacteriologist who examines the samples of water should have first-hand knowledge of the sources of them.

Research Work.—During the year the *Ceylon Journal of Science* came into existence, and the medical section of this paper is edited by the director of this institute. Any research work of importance which is carried out at this institute will be published in this journal.

Much work was done during 1924 on the morphology of bacteria when they are growing under various circumstances such as when growing on 3 per cent. salt agar, or on salt-free agar. It was found that many organisms could be quickly recognized by this method of comparing their morphological appearances on two or more media. Papers on this subject are now in the press.

Work was done on the development of "local" immunity to *B. pestis* and *B. anthracis*. Various vaccines suitable for administration by the mouth or application to the skin were prepared from these organisms, and attempts were made to immunize rabbits and guinea-pigs by feeding the vaccines to them or rubbing the vaccines into the skin. But as far as these organisms are concerned, immunity sufficient to protect the animals from plague or anthrax did not develop in a single rabbit or guinea-pig. The details of this work are being published in the number of the *Ceylon Journal of Science* which is in the press.

Work was done on *B. pyocyaneus*. This organism appears to be pathogenic under three circumstances:—

(*a*) As a secondary invader after such diseases are typhoid. The best example of this was a case of pericarditis following typhoid in which the organism was present in pure culture.

(*b*) As a secondary invader after such diseases sent to this laboratory a number of specimens which have been obtained from a duodenal tube. The specimens have contained *B. pyocyaneus*. And in two cases when the symptoms have abated and the patients have returned to normal health *B. pyocyaneus* ceased to be present in the duodenal fluid.

(*c*) *B. pyocyaneus* has been isolated on a number of occasions from light-coloured choleraic-like contents of the ileum which have been obtained from patients who have died suddenly with symptoms resembling cholera. We have never isolated *B. pyocyaneus* from cases of cholera when the *V. choleræ* has been present.

It appears probable that in Ceylon there exists an acute intestinal disease closely resembling cholera, but which is due to a highly virulent strain of *B. pyocyaneus*.

Another organism which requires further investigation is one which closely resembles *B. diphtheriæ* and which has been isolated from chronic ulcers of the leg and from a peculiar type of throat ulceration.

B.—Pasteur Institute.

During 1924, 398 patients were treated for dog bites. Besides these a large number of persons sought advice at the institute.

The number of patients who have been admitted for treatment at the institute since its opening up to the end of 1923 is 1,777, and 21 of these have died of hydrophobia. This is 1·18 per cent. of failures.

Summary of Results of Research Work done in the Municipal Bacteriological Laboratory during 1924 by Dr. L. Fabian Hirst, Municipal Bacteriologist, Colombo.

(1) The flea survey of Colombo was completed. The total number of fleas examined in the course of the survey was 10,994 taken from 3,331 rats of all species.

The town was divided into fifteen districts, including the Customs premises and Government granaries.

The co-efficient of correlation between percentage *Xenopsylla cheopis* to total rat fleas and human plague incidence per 10,000 of population in the fourteen inhabited districts was ·95 probable error ·02. The various factors which might produce a spurious correlation between cheopis prevalence and plague incidence were separately examined. The results were negative.

Similarly a most striking agreement was disclosed between the actual distribution of cheopis-infested premises and the situation of premises where plague rats were found.

The results of the flea survey show that the percentage of *Xenopsylla cheopis* found on rats in the Government granaries and Customs premises is much higher than elsewhere. An equally high proportion of *X. cheopis* is found on rats caught in the municipal grain boutiques.

The *X. cheopis* found during the flea survey on the rats of Fourth Cross Street, where much grain other than rice is stored, were 45·9 per cent. of 274 fleas. During the epizootic of rat plague, which took place in that street during November, 1923, the proportion of *X. cheopis* rose to 80 per cent.

The rats caught in Bankshall Street, which also contains much imported grain, during the flea survey harboured 44·8 per cent. *X. cheopis* out of a total of 58 fleas.

The proportion of *X. cheopis* in the outlying markets at Dean's Road and Nagalagam Street, where a strictly limited amount of grain is permitted to be stored, was 7 to 8 per cent. In the outlying districts of the town the percentage of *X. cheopis* varied from 2 to nil.

Comparative Experiments on the Transmission of Plague from Rat to Rat by means of X. astia *and* X. cheopis.

1. Attempts to transmit plague between rodents have been carried out with 596 *X. astia* in the course of 13 experiments during four plague seasons at room temperature in this laboratory. The results were entirely negative.

(2) Under similar conditions 132 *X. cheopis* transmitted plague to twelve rodents in the course of six separate experiments.

(3) Plague has been transmitted from rat to rat by means of *X. astia* in one experiment carried out at an artificially reduced temperature in a transmission chamber surrounded by a mixture of ice and sawdust. One infective *astia* was found to be typically "blocked" and exhibited the phenomenon of œsophagal regurgitation described by Martin and Bacot. Two other experiments on the same lines gave negative results. In other words, *X. astia* may carry plague of rats, under climatic conditions favourable to plague transmission.

(4) Contrary to my expectations, plague was continuously transmitted to a series of rats in succession by the same batch of infected *X. cheopis* at room temperature during March, 1924, under climatic conditions particularly favourable to plague transmission.

(5) It is comparatively easy to obtain heavy growth of plague in the stomach of *X. astia* fed upon infected plague rats. There is evidence, however, that blocked *astia* may have relatively low vitality and bite rats but feebly at tropical temperatures.

(6) No evidence has yet been obtained of any marked difference in the virulence of *B. pestis* after growth in the stomach of *X. astia* and *X. cheopis*.

Spinal Analgesia by Dr. Lucian de Zilwa, Physician, General Hospital, Colombo.

In November, 1922, I did my first operation with spinal analgesia caused by injecting a bulb of stovaine into the spinal canal in the lumbar region. Since then all major operations have, whenever possible, been done under stovaine. In 1922, 12 operations were done under stovaine; in 1923, 67; and in 1924, 145. The smallness of the earlier figures is explained by the difficulty in obtaining stovaine in sufficient quantity. The almost total prevention of shock, and the completeness of abdominal relaxation with a localized anæmia, make stovaine an ideal anæsthetic for major operations. It is not given for minor operations like curettage of the uterus. Only in one instance was there a misadventure, where the patient lay down almost immediately after the injection had been given Since then particular care has been taken to keep the patient either seated or with head and neck elevated for ten minutes after the injection.

In 14 of the above 224 cases of spinal analgesia it was found necessary to administer a little chloroform, either because the patient was nervous, in spite of being analgesic, or because at the end of a long operation there were indications of a recovery of sensibility. In four cases no analgesia was produced, although two bulbs of stovaine had been injected into the spinal canal. One of these women admitted drinking about two bottles of arrack daily.

In none of the cases were there any unpleasant effects observed. Even the severe headache, on which much stress is laid in the literature, was only noted in four of the patients.

A Brief Résumé of a few interesting Cases by Dr. A. M. de Silva, Surgeon, General Hospital, Colombo.

Intestinal Obstruction due to a Meckel's Diverticulum which was gangrenous. In this case the Meckel's diverticulum had formed a noose round a coil of small intestines and tightly constricted it producing acute obstruction—the end of the diverticulum was firmly attached to the mesentery. The whole of the diverticulum, together with a portion of intestine to which it was attached, was gangrenous. The gangrenous portion was resected and intestinal anastomosis done. The patient made an uninterrupted recovery.

Intestinal Obstruction due to the Vermiform Appendix.—A somewhat similar case, only in this patient the appendix formed the band and was not gangrenous. It was acutely inflamed and firmly attached to the mesentery of the ileum. A loop of small gut was tightly constricted by it and on relieving the obstruction small patches of gangrene were found in the constricted area which were invaginated by purse-string sutures. The patient made an uneventful recovery.

Goitre.—10 operations were performed for this during the year. 8 of these were for adenomata and 2 for exophthalmic goitre. 5 of them were males and 5 females. Goitres of all varieties seem to be just as common in males as females in Ceylon. *Parenchymatous goitres* were frequently met with both in boys and girls in association with enlarged tonsils and adenoids, in these patients

when the tonsils and adenoids were removed the goitre markedly diminished in size and in no case was operative treatment required for the goitre.

Lingual Goitre.—Lingual goitres are rare. The tumour was removed from an adult male, aged 28, by an incision in the middle line of the neck extending from the symphysis to the hyoid. The tumour was just in front of the epiglottis, immediately under the mucous membrane, projecting into the pharynx and obstructing the laryngeal orifice. It was of the size of a mandarine orange. It was very vascular—a solid adenoma. Preliminary laryngotomy and tracheotomy were done as there was no palpable thyroid in the normal site, a small part of the tumour was left behind to prevent the superventure of myxœdema. The patient, although complaining of dyspnœa for a few days after the operation, made an uneventful recovery and left hospital greatly relieved.

Sacro-coccygeal Tumour.—A very large sacro-coccygeal tumour was successfully removed from an adult male—it was present from birth and was of the nature of teratoma. There was no communication with the spinal canal.

Meningocele.—A large meningocele was removed from an infant eight days old. The tumour was much larger than the infant's skull, the skin over it was thin, atrophic, and ulcerated in places. It was attached to the skull at the external occipital protuberance and communicated with the fourth ventricle. After operation the infant seemed to be getting on well, but died on the eighth day with signs of meningitis.

Granuloma of Nose causing complete Occlusion of both Nasal Cavities.—Two cases were operated on during the year, one an adult male and the other a female. Both nostrils were completely occluded by hard, firm granulation tissue of many years' duration. This tissue projected outside the nasal projections on to the face, disfiguring the patient, filled up both nasal cavities completely and also the nasopharynx; nasal breathing was absolutely impossible, the mouth was kept constantly open. Although the tissue removed was carefully examined microscopically and bacteriologically the cause of this rare condition could not be ascertained. Wassermann reaction was negative, but, in spite of this, injections of salvarsan were administered without any appreciable improvement in their conditions. The operations consisted in burrowing two tracts through the dense granulomatous masses and introducing drainage tubes, thus restoring nasal breathing. On removal of the tube the tracts tend to close, so that they were kept in and the patients discharged with the tubes *in situ*.

Splenectomy was performed three times during the year for chronic malaria—the largest spleen removed weighing 8½ lb.

Internal Ear.—Two operations were successfully performed on the labyrinth for suppuration extending to this region. After the usual radical mastoid the lateral sinus was exposed and the bone in the angle between the external semicircular canal and facial canal was chiselled into until the external semicircular canal, vestibule posterior semicircular canal and cochlea opened up. In both cases the discharge ceased after the operation.

Cancer.—The number of cases of this complaint admitted to the wards seems increasing every year, and unfortunately the majority of cases are in an inoperable stage. In some of these inoperable cases Bell's treatment (raw vegetable juices and injections of sodium cacodylate) was tried, certainly with beneficial results, though in no case had a definite cure resulted.

Injury to the Thoracic Duct in the Thorax.—This was a result of a stab wound on the left side at the level of the eighth dorsal vertebra. The patient—a lady—three months pregnant was assaulted at Badulla, where she was treated for the first few days. When admitted to the General Hospital the external wound was completely healed, but there were signs of free fluid in the pleural (left) and peritoneal cavities, causing severe dyspnœa. On aspirating these cavities large quantities of chylous fluid were removed. But the fluid, both in pleural and peritoneal cavities, quickly reappeared (within a day or two) so that repeated tappings were necessary. The pleural cavity was aspirated more than a dozen times and the abdominal cavity was also tapped about an equal number of times. After each tapping she was greatly relieved, but the fluid speedily recurred and she also aborted whilst in hospital. As tappings were required so frequently I was obliged to make a permanent opening in the thorax by resecting a portion of the rib. Although the patient was greatly relieved by this operation—the fluid ceasing to accumulate in both pleural and peritoneal cavities—she had a sinus discharging chyle continuously and was wasting rapidly. In spite of regulation of diet, &c., she continued to lose flesh and eventually died in a comatose condition several months after the original assault.

Reductio en Masse (Strangulated Hernia).—One case of *reductio en masse* was operated on during the year. The remarkable feature about this case was that the patient himself produced the *reductio en masse*. The hernia, which was previously reducible, came down and got strangulated and he was seized with violent pain and vomiting. In desperation he squeezed the whole forcibly inside the abdominal cavity—only to find that although the external swelling had completely vanished there was absolutely no relief to his symptoms—the pain was even more severe than before, and the vomiting continued. At the operation it was found that the *reductio en masse* was of the recto-peritoneal type (the sac with its contents lying between the iliac fossa and peritoneum) and the intestine was gangrenous in places. After operation patient made an uneventful recovery.

Some important factors in the causation of diabetes mellitus in Ceylon (based on a brief survey of 200 selected cases), by Dr. Lionel de Silva, physician, General Hospital, Colombo.

Funck has rightly stated that the diagnosis of

diabetes mellitus means no more than the diagnosis of fever. The chief manifestations of this disease have been recognized since the days of Celsus, and it is said that Aræteus, in A.D. 150, was the first to call this syndrome complex ætiology "diabetes mellitus." Attempts have been made from time to time to regard diabetes as a definite disease, but the researches on the biochemistry of the blood and urine during the last decade have proved the correctness of Solis-Cohen's dictum: "I do not know of any definite disease called diabetes mellitus." Hindu medical literature of the sixth century refers to this disease as "madhumeha" or honey urine, and describes it so vividly that Chander Bose's translation seems worthy of repetition. Madhumeha is a disease which the rich principally suffer from, and is brought on by their over-indulgence in rich flour and sugar. The patient feels weak and emaciated and complains of frequent micturition, thirst, and prostration, ants flock round his urine, carbuncles and phthisis are its frequent complications. This classical description adequately describes the state of the diabetic in Ceylon to-day. Careful observation and improved technique have enabled us to investigate further as to whether it is the liver, stomach, kidney, pancreas, or the nervous system which refuses first to respond to the constant strain of over-indulgence in food, alcohol, &c. The somewhat premature enthusiasm of the lay press over the valuable discovery of insulin has unfortunately created an atmosphere of optimism among sufferers, who seem to ignore the fact that several causes, operating individually or collectively, may give rise to these common symptoms which go under the somewhat unfortunate term "diabetes."

An ætiological survey of 200 cases based on clinical and biochemical observations during the last four years showed primary pancreatic involvement in only four cases.

Age when disease was first recognized:—90 out of 200 were just under 40 years, 76 out of 200 were between 40 and 50 years, 23 out of 200 were between 50 and 60 years, 11 out of 200 were over 60 years. The average age incidence of the cases under 40 years was 38 years.

It is worthy of note that the first appearance of this disease in the majority of cases in this series is much earlier than almost all other countries, including India. In European countries, especially in Southern Europe, the average age incidence has been 50 years. In Dr. Bose's series of 325 cases the majority of patients were over 40. This higher age incidence in India may be due to the fact that the individual Ceylonese is relatively more prosperous than his brother in India.

The stages in the life history of the average diabetic in Ceylon may be summed up as follows:—(*a*) Material prosperity; (*b*) over-feeding by parents, excessive indulgence in rich food and sweets; (*c*) sedentary occupation; (*d*) suralimentation leading to hepatic congestion; (*e*) occasional glycosurias due to hepatic insufficiency and in some cases excessive functional activity of the liver; (*f*) constipation and often hæmorrhoids become well-marked features in the case; (*g*) persistent glycosuria with hepatic lesions. This is the stage at which the physician is first consulted; (*h*) case becomes diabetic without denutrition, suralimentation still continued. Liver slightly enlarged, high blood-pressure and renal sclerosis. Patient eventually dies of uræmia. Average expectation of life seems to be about 10 to 15 years from onset of symptoms; (*i*) patient may become a diabetic with denutrition. Hepato-pancreatic cirrhoses with serous diabetes develops, about 5 per cent. of cases in this series.

Splenectomy, Intestinal Obstruction due to Worms, Extra Uterine Pregnancy and Perforated Typhoid Ulcer with Peritonitis, by Dr. Catherine E. Anderson, Medical Officer in Charge, Lady Havelock Hospital for Women, and Lady Ridgeway Hospital for Children, Colombo.

Case 1.—Joseph, aged 8, a resident of Ambepussa, was admitted into the Lady Ridgeway Hospital on June 9, 1924, with enlargement of abdomen and a history of intermittent fever for two years. On examination the spleen was found to be filling up the whole of the left side of the abdomen and extending across the middle line one inch to the right of the umbilicus and below down to the symphysis pubis. Blood filter showed malaria parasites. Patient given a course of iron and arsenic and quinine treatment. Splenectomy was done on July 4, 1924. Spleen weighing 1¾ lb. was removed through a vertical incision through the left rectus. He made an uninterrupted recovery and was discharged fit on August 21, 1924.

Case 2.—Caroline, aged 5 (Sinhalese), was admitted into the Lady Ridgeway Hospital on November 17, 1924, with a history of attacks of abdominal pain and vomiting and fever for 5 days, also the passage of only blood and mucus *per rectum*. The mother said she noticed a "lump" appearing in the abdomen from time to time. On admission temperature was 100° F., pulse 140; a tumour could be felt extending from under the right costal margin across the abdomen above the umbilicus to the left hypochondriac region. Several enemas were given and blood and mucus only were passed *per rectum*. Diagnosis of obstruction high up in the small intestine was made due to intussusception or possibly *Ascaris lumbricoides*. Laparotomy was done on the evening of admission through a vertical incision through the right rectus. About 18 inches of the jejunum was found to be packed by a solid mass of round worms. It was found impossible to "milk" them down the bowel, so enterotomy was done. Through this the worms, numbering about 800, were removed in masses by means of forceps—the worms being "worked" towards the aperture in the bowel until the whole mass was evacuated. A double row of silk suture closed the bowel and the abdomen was sutured up in the usual way. Saline and glucose *per rectum* were given for the next 24 hours. On November 19, 1924 (i.e., two days after the operation), ½ gr. of santonine, preceded and followed by ol. ricini, was given, but no worms were passed.

Colonial Medical Reports.—No. 193.—Ceylon (*continued*).

On November 20, 1924, the child passed a normal motion. Apart from a little suppuration at the lower part of the skin wound the child made an uneventful recovery. On December 6, 1924, round worm ova were found in the fæces. On December 7, 1924, carbon tetrachloride (♏ vii) was given to remove any hookworm that might be present.

Before the child left hospital santonine and oil of chenopodium were administered, but no round worms were passed. She left hospital on January 15 perfectly well.

Case 3.—A Sinhalese lady, aged 34, was admitted into the Lady Havelock Hospital on October 3, 1924, giving a history that she was 10 months pregnant and had no signs of labour pains. Breast signs were absent. She said she had amenorrhœa for 6 months and after that bleeding off and on for the last 4 months.

On admission a solid, hard, lobulated tumour was found filling up the lower abdomen and extending to a level one inch above the umbilicus on the left side. On the right and continuous with the tumour was a hard nodule.

She had three children, the youngest aged 10. Laparotomy was done the day after admission and a tumour consisting of six months' dead fœtus was removed with great difficulty, enclosed in a sac formed by the layers of the broad ligament. Omentum and bowel were firmly adherent, which made the operation exceedingly difficult. As it was impossible to separate the tumour from the uterus a subtotal hysterectomy was done—the tumour being firmly attached to the left side of uterus. The nodule that was felt abdominally was the fundus of the uterus. Remains of the tube and ovary were found on the upper surface of the tumour. This, then, had been a case of tubal gestation with extra-peritoneal rupture between the layers of the broad ligament, i.e., an intraligamentary rupture with survival of the fœtus up to six months. Death of the fœtus took place four months previous to admission, and this corresponded to the time the bleeding started from the uterus. Apart from the presence of a tumour the patient suffered no discomfort. The wound healed up by first intention, and the patient was discharged from hospital three weeks after admission, getting very well.

Case 4.—Seeman (Sinhalese), aged 6, was admitted to the Children's Hospital on October 23, 1924, having been brought in a bullock cart from a village thirteen miles north of Colombo, with a history of having had fever for eight days and abdominal pain for three days. On admission his pulse was 120, and temperature 101·4° F., abdomen was very distended, rigid and tender all over. Bowels had not moved for two or three days and an enema was given with a "pea-soupy" result on the morning of October 24, 1924, pulse was 98 and temperature 97·8° F., and abdomen was still tender and rigid. By 2 p.m. pulse was 120, and the patient was crying out with abdominal pain. Laparotomy was done immediately and the abdomen was found to be full of pus Intestine was examined carefully and fæces were found oozing out of an aperture surrounded by a red area in the ilium about three inches above the iliocæcal valve. The aperture was quickly closed with a purse-string silk suture. The abdominal cavity was swabbed out as dry as possible and drainage tubes were inserted into Douglas' pouch and the right and left iliac fossa. Abdomen was closed, except lower end for the tubes, and the patient was nursed in the Fowler position. Saline glucose and soda bicarb. were given four-hourly per rectum.

October 27, 1924, blood was sent for Widal examination and the result was 1/40 positive, 1/80 negative. Temperature was normal and continued so. The wound discharged freely and rubber drainage was not got rid of till November 13, 1924. The patient progressed favourably, and the abdomen wound healed without any complication. The child was circumcised and discharged fit from the hospital on December 11, 1924.

Stovarsol in Amœbiasis, by Dr. Frank Grenier, Senior Physician, General Hospital, Colombo.

It has long been recognized that infections with *Entamœba histolytica* once established are remarkably persistent. Spontaneous disappearance of the parasites has never been proved to occur, and many cases are known in which an affection has lasted for years—certainly for 16 years—and probably for much longer periods.

The results of treatment of these refractory cases of chronic amœbic dysentery, and of chronic non-dysenteric amœbiasis have often proved disappointing. The experience of recent years, and the knowledge gained by systematic examination of stools in chronic amœbiasis have shown how this condition may clinically simulate sprue, and that its symptomatology, apart from dysenteric manifestations, is very complex and may imitate almost any gastro-intestinal disturbance, and that it is responsible for much chronic invalidism in the tropics.

Neither emetine nor emetine-bismuth iodide, nor the newer preparation, emetine periodide, are specific cures for amœbiasis. They are valuable drugs, but they do not always eradicate the infection or prevent relapses. For the incurable residue other methods of treatment had to be advised. Workers in France some years ago had recommended salvarsan in the treatment of these cases, but such treatment did not enjoy a long vogue.

In 1923 Professor Marchoux, of the Pasteur Institute, having observed the good effects of stovarsol given by the mouth in syphilis was stimulated to try it in amœbic dysentery. In his first case thus treated the cysts of *Entamœba histolytica*, which had persisted after a course of emetine, rapidly disappeared, and success was equally remarkable in chronic cases of amœbic dysentery.

Stovarsol or oxyaminophenylarsenic acid is but slightly toxic, easy to take, and after an extended use I have not observed any detrimental effect which can be attributed to the drug.

Report of some cases of chronic amœbiasis treated in hospital during the year with stovarsol:—

Case 1.—F.W., Burgher, dysentery, 10 years ago. Mother died of sprue. During last two years has been treated for sprue, sore tongue, and morning diarrhœa, bulky, pale, frothy stools, emaciation. While in hospital undergoing treatment for sprue—parathyroid and calcium and diet—his stools were daily examined. On the 11th examination typical cysts were found. A regular course of stovarsol was prescribed and continued after discharge. Patient improved rapidly, is now doing a full day's work and on practically ordinary diet, and repeated examination of fæces has been negative.

As regards the resemblance of chronic amœbiasis to sprue, I may quote the views of Acton and Knowles, of the Calcutta School of Tropical Medicine:—"Whilst sprue appears to be a clinical entity, may not it be the end phase of several different infections, e.g., with the Flexner bacillus, or after chronic amœbic dysentery associated with pancreatic and parathyroid deficiency?"

Case 2.—Recurring dysentery of two years' duration. In spite of several courses of emetine, intravenous salvarsan, colonic irrigations, &c., the condition tended to relapse. Rapid improvement under stovarsol and restoration to normal health.

This patient was a municipal employee, and the municipal bacteriologist informs me that repeated examinations of the fæces have given a negative result and that, moreover, a very chronic dermatitis the patient had had disappeared. These skin conditions are met with in amœbiasis, and are probably due to secondary streptococcal lesions in the bowel and absorption of "pressor" bases.

Case 3.—Recurring dysentery of 5 years' duration. Attacks every 3 or 4 months—an assistant at the Bacteriological Institute. Cysts could always be demonstrated in his fæces. Treated with stovarsol. Numerous repeated examination of stools now "negative." No recurrence for nearly one year.

Case 4.—Female. Dysentery 10 years ago. Recurring attacks of diarrhœa, last 6 months persistent diarrhœa. On admission extreme emaciation, hectic fever, prostration, a "living skeleton." Condition thought to be either sprue or abdominal tuberculosis. On eighth examination of fæces, cysts found. Improvement, though slow, was sure, and patient, who has been recently, had put on weight and was free of symptoms. This case treated with "yatren," and not stovarsol.

Case 5.—European male. Complained of dyspepsia and had symptoms of neurasthenia. Illness of 6 years' duration and dated back to war service in Egypt. Referred to his condition as "Egyptian Tummy." This case was one of chronic amœbiasis, where marked constipation, rather than diarrhœa was a symptom. Cysts found. Improved, and now in good health.

Case 6.—Female, English. Ill for 4 years with "colitis." Appendix removed last year, no benefit from operation. This case is illustrative of the fact that chronic amœbiasis may give rise to symptoms and signs of chronic appendicitis. Patient improved, stools became normal in character and frequency and were, on repeated examinations, "negative" for cysts. However, for a considerable time the patient's general health remained poor, and she manifested symptoms characteristic of the "confirmed abdominal neurasthenic," the condition being probably due to endocrine deficiency, the result of chronic intestinal sepsis. Many such cases of chronic amœbiasis finally drift into the "chronic abdominal type." One such case after "suffering many things at the hands of many physicians" finally received salvation and restoration to health from Christian Science. I may mention that in a recent case of chronic amœbiasis with symptoms of chronic appendicitis, the appendix was removed and numerous active motile amœbæ were found in the appendix, which was thickened and showed signs of chronic inflammation.

The Misuse of Emetine.—Whilst emetine is a most powerful drug, it is not sufficiently realized that it is a powerful cardiac and central nervous system depressant. The emetine is often given without justification for its use, often on the mere strength of symptoms of hepatic or intestinal disorder, and is to be deprecated. I have personally known of two cases of fatal cardiac failure from overdosing with emetine.

Stovarsal in Acute Amœbic Dysentery.—I have not given stovarsol a trial in cases of acute dysentery. It is the practice of some French medical men to give a continued course of emetine and stovarsol. It is claimed, however, that stovarsol is so efficient and so easy to give by the mouth that patients in private practice and those who cannot come often to hospital are treated with stovarsol alone.

Report of the Malariologist, Mr. H. F. Carter Scientific Section.—The information included in this section comprises brief summaries of certain investigations undertaken during the past year or more. The results of these and other investigations will be published in detail later, and will include a series of articles in the *Ceylon Journal of Science*.

Endemic Prevalence of Malaria in Ceylon.—The relative prevalence of malaria in different parts of the island was determined by spleen and blood examinations of random samples of children. The majority of these examinations were made in connection with a preliminary survey during the period July, 1921, to July, 1922, when, owing to limitations of staff and the extensiveness of the area involved it was not possible to synchronize the work with climatic conditions or to complete it within either of the monsoon periods. For these reasons the examinations were not in all cases strictly comparable, and factors—e.g., recoveries, relapses, &c.—influencing the rates were operating in varying degrees in different districts when the work was performed. The results of continued work in this connection, however, have not affected the figures given in the report for 1922 to any appreciable extent, and it may perhaps be justifiable to assume, therefore, that, as applied to the extensive areas mentioned, the findings afford a fairly reliable estimate of the

prevalence of the disease. Nevertheless, local and seasonal variations may be considerable and apparently are particularly liable to occur in areas of relatively low or moderate endemicity.

The endemicity of malaria varies considerably in different parts of the island, and that, in certain areas at least, such variations are coincident with changes in climatic and topographical conditions. Broadly speaking, the following areas of endemicity—as indicated by the spleen rate—may be distinguished.

Splenic Values.—The determination of the spleen rate (of children from 2 to 10 years of age), although of great practical value as a means of measuring the amount of malaria present in any given district, does not afford a true indication of the intensity of the disease, since the exact signification of the rate is unknown. When, however, the size of the enlarged spleen is observed, more valuable and precise information at once becomes available, as it has been shown that a definite mathematical relationship exists between the size of the spleen and the spleen rate. The proportions of the different classes of spleens change regularly with the spleen rate, ensuring for individual rates a comparatively stable formula. The latter, however, may be considerably influenced by certain factors, e.g., non-representation of the community examined particularly in regard to the inclusion in communities with low spleen rates of children from highly malarious districts, or the presence of some other disease productive of severe splenomegaly; and when such are present the proportions of the different classes of spleens may be at complete variance with those for the observed spleen rate.

The changes in the spleen composition (exclusive of obvious discrepancies) correspond fairly closely with those found by Christophers in India and Mesopotamia, although there appears to be a definite decrease in the proportions of large-sized spleens for each group of spleen rates.

According to Christophers a *splen* is the mean increase in splenic substance resulting from a single infection (untreated) in a child 2 to 10 years of age, and the number of *splens* distributed is a direct measure of the intensity of malarial infection. The value of the *splen* being known the latter may easily be calculated, and from this the spleen rate corresponding to the spleen composition may be obtained. The average values of the *splen* in India and Mesopotamia have been determined at 90 and 114 grm., respectively, while that for Ceylon—owing to the difference in size of enlarged spleens—is less, being approximately 80 grm.

The Relative Prevalence of the Different Species of Malarial Parasites.—The results of examinations show that in every district the benign forms (benign tertian and quartan) of malaria predominate; malignant or subtertian malaria appears to be relatively uncommon, averaging only slightly over 10 per cent. of all infections observed. The figures now given differ in several respects, especially in regard to the relative prevalence of quartan malaria, from those in the report for 1922; but all such discrepancies are evidently due to the comparatively small numbers of "positive" films which were available for analysis at that time.

The relative scarcity of malignant malaria in Ceylon is a matter of considerable interest and importance, since in most tropical countries this form of the disease preponderates, and is concomitant with a high prevalence of pernicious cases and severe mortality. It is, moreover, considered by some authorities that the parasite (*Plasmodium falciparum*) responsible for this form of malaria is the chief causal factor of blackwater fever, and that the presence of this organism in a high portion of infections is necessary for the production of this condition. If this view be correct, the almost complete absence of blackwater fever from Ceylon —even from those districts where malaria is hyperendemic—may readily be explained by the results shown. It is very probable, however, that the percentage proportions of the various species of parasites in the different areas are subject to seasonal fluctuations, and that at certain times any one species may become more prevalent; but the evidence at present available indicates that in the case of malignant malaria a widespread increase sufficiently great to render it the predominating form is not a common occurrence.

The Differential Characters of the Indigenous Anopheline Mosquitoes in their Adult and Larval Stages.—Fifteen species, and their varieties, of anopheles have now been found in Ceylon. Of these, nine are abundant, including two (*A. maculatus* and *A. gigas*) which are confined to the hill country. In the low country, although the same species occur in both the wet and the dry zones, they are present in very different proportions. In the wet zone *A. listoni* and *A. culicifacies* are relatively uncommon, and are, to a great extent, replaced by the comparatively innocuous swamp-breeding species, *A. jamesi*, *A. hyrcanus* and *A. barbirostris*. Proceeding from the wet zone to the dry zone districts, the proportions of the various species gradually change, those of *A. subpictus*, *A. listoni*, *A. culicifacies* and *A. fuliginosus* being increased, while those of the "swamp breeders" mentioned above are correspondingly reduced. It would appear probable that this change in the composition of the anopheline fauna is a factor of fundamental importance in connection with the relative freedom of the low country wet zone (i.e., the south-west portion of Ceylon) from malaria and it is of interest to note that in several instances (e.g., Mutwal, 1903; Mahara Jail, 1922; Dematagoda, 1923) during recent years when localized epidemics have occurred in this part of the country, conditions have been present which especially favoured the propagation of *A. culicifacies* or *A. listoni*.

The more important distinguishing characters of the adults and mature larvæ of the indigenous anopheles are summarized in the following tables:—

Synopsis of Adults.

(1) Wing entirely dark, or the upper margin with not more than three pale spots; cross-veins and bases of forks of veins dark (subgenus *Anopheles*).

Wings with at least four pale spots on the upper

margin; cross-veins and bases of forks of veins pale (subgenus *Myzomyia*).

(2) Wings without pale spots; uniformly brown in colour (*aitken* James).

Wings with light and dark spots.

(3) Wings with three pale spots on the upper margin, the markings sharply defined; large species (*gigas* Giles).

Wings with at most two pale spots on the upper margin, the markings not sharply defined; medium sized or large species.

(4) Hind legs with a dense tuft (black and white) of outstanding scales on the femora (*annandalei* Pras.).

Hind legs normal without a tuft of outstanding scales.

(5) Femora, tibiæ and first tarsal segments of all the legs conspicuously spotted with yellow (*pseudo-barbirostris* Lud.).

Femora, tibiæ and first tarsal segments with pale spots at their extremities only.

(6) Palpi in female entirely black, shaggily scaled, in male black with an indistinct ring on the proximal portion; wings with black and white scales, the black preponderating; large blackish species (*barbirostris* Wulp).

Palpi in female with narrow pale rings, in male with distinct rings and the apex of the club white, wings with black and yellow scales, the yellow preponderating on the lower portion of the wing; medium-sized to large, dark brown species (*hyrcanus* Pall.).

(7) Femora and tibiæ with pale spots at or near their extremities only.

Femora and tibiæ conspicuously spotted throughout with white or yellow.

(8) Tarsal segments of all the legs entirely dark.

Tarsal segments with distinct pale rings.

(9) Thorax brown; palpi in female with three narrow widely separated rings, in male with pale rings, the club mainly dark scaled; base of first vein mainly black, fringe dark or with one or two indistinct pale spots (*culicifacies* Giles).

Thorax mainly gray; palpi in female with three pale rings, the two terminal ones broad and narrowly separated, in the male with pale rings, the club mainly yellowish; base of first vein yellow, fringe with several conspicuous pale spots.

(10) Proboscis entirely dark, sometimes paler beneath the apical half; fringe without a pale spot opposite the sixth vein (*funestus* var. *listoni* List.).

Proboscis conspicuously pale (golden) on the apical half; fringe with a pale spot opposite the sixth vein (*funestus* var. *aconitus* Don.).

(11) Tips of the hind legs dark; pale bands on tarsal segments of fore legs broader than those on the hind legs.

At least the tips of the hind legs white; pale bands on tarsal segments of fore legs, narrower and less conspicuous than those on the hind legs.

(12) Palpi in female with three pale rings, the apical ring not more than 1½ times the length of the adjoining black band; proboscis uniformly dark; fringe usually with an extra pale spot between the fifth and sixth veins; tibiæ and first tarsal segments with conspicuous longitudinal striping (*subpictus* Grassi).

Palpi in female with three pale rings, the apical ring very broad, at least 3 times the length of the adjoining band; proboscis in female with a pale area before the apex; fringe usually without a pale spot between the fifth and sixth veins; tibiæ and first tarsal segments without pronounced striping (*subpictus* var. *vagus* Don.).

(13) Hind legs with the last three tarsal segments entirely white; palpi in female with three white rings (*fuliginosus* Giles).

Hind legs with the tip (last segment) only white; palpi in female with four white rings (*karwari* James).

(14) Pale markings on the second to sixth veins extensive; often forming relatively large bars; sixth vein with not more than three dark spots.

Pale markings on the second to sixth veins interrupted by very numerous small black spots; sixth vein with at least four dark spots.

(15) Hind legs with the last three tarsal segments entirely white; palpi in female with three white rings the second narrow and widely separated from the apical ring (*jamesi* Theob.).

Hind legs with the tip (last segment) only white; palpi in female with three white rings, the apical ones broad and narrowly separated (*maculatus* Theob.).

(16) Hind legs with a very broad white band covering the tibiotarsal joint (*leucosphyrus* Don.).

Hind legs without such a band (*punctulatus* var. *tessellatus* Theob.).

Synopsis of the Mature Larvæ.

(1) Shaft of antenna with a branched hair, or if absent the post-antennal hairs short and inconspicuous. (Subgenus *Anopheles*.) Shaft of antenna without a branched hair, the post-antennal hairs always long and conspicuous. (Subgenus *Myzomyia*.)

(2) Shaft of antenna without a branched hair, post-antennal hairs small; thorax and abdomen completely covered with minute curved setæ (*annandalei* Pras.).

Shaft of antenna with a branched hair, post-antennal hairs large; thorax and abdomen without setæ.

(3) Outer clypeal hairs with a few short branches, or simple; hair on antenna arising near base of shaft.

Outer clypeal hairs thickly branched dendriform; hair on antenna arising near middle of shaft.

(4) Thoracic palmate hair vestigial with four or five hair-like divisions; abdominal palmate hairs with leaflets terminating bluntly; large species (7 mm.) (*gigas* Giles).

Thoracic palmate hair well-defined with several (10-14) narrow leaflets; abdominal palmate hairs with leaflets terminating in definite filaments or very sharp points; small species (3·5 mm.).

Colonial Medical Reports.—No. 193.—Ceylon (*continued*).

(5) Inner and outer clypeal hairs branched, the former usually bifurcating before the middle (*aitkeni* James).

Inner and outer clypeal hairs simple (*aitkeni* var. *insulæflorum* Swel.).

(6) Innermost submedian anterior thoracic hairs branched (6·8 divisions) from or near the base; black with white markings (*barbirostris* Wulp).

Innermost submedian anterior thoracic hairs simple, or with two or three very short branches arising on the distal portion of the stem; yellowish-green or yellowish-brown without definite white markings (*hyrcanus* Pall.).

(7) Abdominal tergal plates very large, occupying from nearly one-half (first segment) to almost the whole (eighth segment) of the dorsal surface of the segments.

Abdominal tergal plates smaller, those on the anterior segments reduced to narrow transverse bars.

(8) Inner and outer clypeal and pre-antennal hairs simple, or (intermediate form) with a few short branches, those on the pre-antennal hairs arising at intervals along the stem (*funestus* var. *listoni* List.).

Inner and outer clypeal hairs with more numerous short branches, pre-antennal hair branched (5 or 6 divisions) from the base (*funestus* var. *aconitus* Don.).

(9) Outer clypeal hairs simple, or with a few short branches only; pre-antennal hairs simple, or with faint lateral branching.

Outer clypeal hairs thickly branched, plumose; pre-antennal hairs branched, usually from the base.

(10) Inner and outer clypeal hairs simple, or the inner only with fine, short, lateral branches; thoracic palmate hair (except *A. subpictus*) small, but with definite leaflets.

Inner and outer clypeal hairs with short lateral branches; thoracic palmate hair with hair-like divisions only.

(11) Anterior clypeal and pre-antennal hairs always simple; leaflets of abdominal palmate hairs ending in long filaments.

Inner clypeal hairs usually with short branches; leaflets of abdominal palmate hairs ending in blunt points.

(12) Thoracic palmate hair vestigial, with long hair-like branches; submedian thoracic hairs scarcely pigmented, the innermost without a conspicuous dark root; antennæ feebly chitinized, unpigmented.

Thoracic palmate hair small, but with six to eight short leaflets; submedian thoracic hairs powerful, pigmented, the innermost with a conspicuous dark root; antennæ strongly chitinized, the tips dark (*culicifacies* Giles).

(13) Pre-antennal hairs situated below or outside the inner clypeal hairs; outer clypeal hair long—from $\frac{2}{3}$ to $\frac{3}{4}$ the length of the inner (*subpictus* Grassi).

Pre-antennal hairs situated between the inner clypeal hairs; outer clypeal hair very short—$\frac{1}{4}$ or less the strength of the inner (*subpictus* var. *vagus* Don.).

(14) Innermost submedian anterior thoracic hairs short, with two or three branches (occasionally simple) without conspicuous roots (*punctulatus* var. *tessellatus* Theob.).

Innermost submedian anterior thoracic hairs large with numerous branches and conspicuous roots (*leucosphyrus* Don.).

(15) Extremities of leaflets of abdominal palmate hairs sharply pointed or filamentous (*maculatus* Theob.).

Extremities of leaflets of abdominal palmate hairs bluntly pointed (*karwari* James).

(16) Vertical clypeal hair long and simple, occasionally bifid; leaflets of palmate hair on first abdominal segment very narrow, usually hair-like, 7-8 in number (*jamesi* Theob.).

Vertical clypeal hair short, with four or five branches arising, usually, from the base; leaflets of palmate hair on first abdominal segment differentiated, 10-12 in number (*fuliginosus* Giles).

The Relation of Paddy Cultivation to Malarial Endemicity.—Investigations in this connection were conducted at several towns situated in different parts of the island with a view to determining the effects of varying conditions upon the anopheline fauna of the rice fields, and the relation of the latter to the incidence of malaria; they were commenced in August, 1922, and continued until November, 1924. The area under paddy at the centres selected considerably—from approximately thirty to several hundred acres. At each centre from ten to thirty fields (varying in total area from one to three acres), situated in three or more blocks in different parts of the town were selected, mainly in accordance with their position in relation to dwellings and irrigation channels.

Examinations for anopheles larvæ were made each month; they were not restricted to the rice fields alone, but included uncultivated fields, irrigation channels, swampy areas and pools produced by seepage, and various other types of potential breeding places in the vicinity.

Except in the wet zone the predominating species of anopheles breeding in the rice fields are *A. subpictus* and *A. hyrcanus*, but the more effective malaria transmitting species—*A. listoni*, *A. culicifacies* and *A. maculatus*—when taken together form an appreciable percentage of the anopheles fauna.

In many parts of the island it would appear at first sight that the irrigation channels themselves are more important factors in the production of malaria than the rice fields, but it is necessary to observe that the total prevalence of anopheline larvæ of all kinds in the channels is in general considerably less than in the rice fields—a fact which, in practice, may tend to equalize matters. It has yet to be determined, however, whether the larvæ of the more important species occurring in the fields are derived primarily from the irrigation

channels or exactly to what extent lack of control of the water supply is responsible for their propagation. Evidence is available which shows that the paludic conditions invariably associated with irrigation are seriously conducive to anophelism of a dangerous type, and that much stricter control—particularly of the privately owned channels—will be necessary if the incidence of malaria is to be reduced.

The average prevalence of the various species of anopheles in the rice fields vary to a greater or less extent in the different areas, chiefly according to the stage of cultivation and growth of the crop. The most definite change is in regard to the species *A. subpictus* and *A. hyrcanus*. Usually, during the early stages of cultivation when there is little or no growth and the water is stagnant and muddy, the predominant species is *A. subpictus*, but in most districts *A. hyrcanus* becomes more prevalent as the growth of vegetation increases, reaching its maximum abundance when the crop is sufficiently tall to shade the surface of the water. No very definite variations in the prevalence of the malaria-carrying species have so far been observed.

Colonial Medical Reports.—No. 194.—Egypt.

ANNUAL REPORT ON THE WORK OF THE PUBLIC HEALTH DEPARTMENT FOR 1922.

Vital Statistics.

The birth-rate for 1922 was 43·2 per thousand, as compared with 42·3 for 1921, and the death-rate was 25·2 per thousand, as compared with 25·3 for 1921.

Kasr el 'Aini Hospital.

Kasr el 'Aini Hospital.—The number of in-patients admitted during the year was 13,074. There was a continuous increase in the number of in-patients admitted in the hospital during the last five years. The death-rate of in-patients in 1922 was 8·35 per cent., as against 9·13 in 1921. The number of out-patients was 122,416, the number of attendances being 353,251.

Encephalitis Lethargica.—13 cases of this disease were admitted during the year as against 3 in 1921. 2 of the cases were of the myoclonic type, and 1 of the cerebellar type. Several cases presented a clinical picture closely simulating paralysis agitans.

Lithotrity versus Suprapubic Lithotomy.—During 1922 51 cases of vesical calculus were treated by lithotrity with 7 deaths. 6 of the 7 cases that died showed, post-mortem, advanced cystitis and pyelonephritis. In the remaining case no definite cause of death was discovered. In none of the 7 cases was there a rupture of the bladder. This mortality compares very unfavourably with statistics of 815 cases done by Freyer on adult males with a mortality of 3·06 per cent.

The mortality from suprapubic lithotomy during 1922 was 10·81 per cent. in 37 cases. The above facts suggest that cases with septic urinary passages stand lithotrity worse than they do suprapubic lithotomy. This, however, is a disputed question and well worth further and more thorough investigation.

Splenectomy.—12 splenectomies were done for endemic splenomegaly during the year. Of these 2 died in hospital. One, two and a half months after operation; post-mortem of the liver showed advanced cirrhosis. The other died of broncho-pneumonia on the third day of the operation. He, too, had advanced cirrhosis of the liver.

8 cases of ruptured spleen were admitted during the year. 5 died before and 3 after operation. 2 of the 8 cases had rupture of the liver as well. The remaining 6 cases had enlarged spleens (malarial or otherwise), hence the high mortality.

Tetanus.—Both the incidence and mortality of tetanus were higher during 1922 than the previous year. Of 16 cases admitted 12 died—a mortality of 75 per cent. Of the 4 cases that recovered, 2 had an incubation period of 17 days and 32 days respectively. The other 2 had no wounds or history of wounds so that the incubation periods could not be ascertained. Of the 12 cases that died 3 had an incubation period of 2 days, 5 days and 10 days respectively; 2 had recent wounds, but the exact time of infliction could not be ascertained. The other 7 cases had no wounds or recent scars, so that, there again, the incubation period could not be estimated.

Hydrophobia.—In spite of an increase in the number of antirabic cases, the number of cases of hydrophobia has decreased.

Of 7 cases of hydrophobia in which the site of the bite was known, in 6 this was the face and in 1 the forearm. Of 11 cases of hydrophobia 6 had no prophylactic treatment and 5 had a complete course.

Ankylostomiasis.—During the past year trial was made of two new anthelmintics for ankylostomiasis namely, carvacrol and carbon tetrachloride. The former drug is a fluid isomer of thymol and, it was thought, might be effective in smaller doses, on account of its liquid character. The results showed that, to be effective, the drug required to be given in about the same amount as thymol (dose 3 c.c.) and did not appear to possess any special advantages.

Carbon tetrachloride was only introduced this last year and investigations were begun before clinical reports on its own use were published. Those now available show that the doses used have been 3 c.c. alone or 5 c.c. with castor-oil. These doses have no toxic action on the liver, and act well without preliminary preparation of the patient.

Our experience at Kasr el 'Aini, so far, is in favour of large doses; a single dose of 3 c.c. being much less efficacious. Excellent results have followed the administration of 6 to 8 c.c. of carbon tetrachloride mixed with about the same quantity of castor-oil, given in two halves at 2 hours interval. Greater dilutions than 1 in 3 of the drug reduce its efficiency. As large a dose as 10 c.c. has been given with no ill-effect, but it must be remembered that the combination with castor-oil minimises absorption.

The drug appears to have a strong bactericidal as well as vermicidal effect. The results obtained compare favourably with those of chenopodium and thymol, and are naturally most striking when a large number of worms are present.

More work is in progress to determine the most effective and economical method of using the drug on a large scale, since it appears a safer and more powerful anthelmintic than those hitherto employed. For this purpose a special annexe has been prepared at Port Said.

Auricular Fibrillation.—Quinine sulphate was tried in 12 cases showing this condition. The diagnosis was made on clinical grounds. 0·040 grm. in tabloid form was given by mouth three times a day. In no case was the fibrillation stopped. The pulse-rate was reduced and the irregularity diminished, but with no obvious advantage. Nausea and vomiting were induced in the majority of the cases.

Bilharziasis.—Oral administration of tartar emetic was tried in 6 cases. Enteric coated pills, each containing 0·06 grm. tartar emetic, were given twice a day. In only one case was the urine reported negative after a course of 20 pills. In another case 40 pills were given, but with no effect. In 4 cases treatment had to be stopped after a few days on account of the onset of vomiting, diarrhœa and colicky pains.

Rectal administration of tartar emetic was tried in 13 cases. The method of administration was as follows: a mild laxative was given at night and in the morning an enema of 100 c.c. distilled water containing the dose of tartar emetic required with 8 mm. tinct. opii. was given with a funnel attached to a soft rubber catheter. Enemata were retained for periods between 8 and 24 hours. 6 gr. of tartar emetic were given to begin with, increasing by 2 gr. each time. The enemata were given every other day. The rectal administration of tartar emetic is far inferior to the intravenous method. A combination of tartar emetic and emetine was found more effective in the treatment of intestinal bilharziasis than either drug used alone. Bismuth was tried chiefly as a possible substitute for antimony in the treatment of bilharziasis. The compound used was the liquor bismuth et ammonii citratis (B.P.) sterilized for intravenous use. Subcutaneous or intramuscular injections proved to be irritating and unsuitable. The results were that slight chronic infections were cured, but an attempt to use larger doses than 1 c.c. (for the treatment of more active infections) was abandoned owing to the development of toxic symptoms. Meanwhile research in France on the action of bismuth in syphilis and spirochætal infections showed that preparations of this metal were ten times as toxic when administered intravenously as when given by intramuscular injection. Further, by suspending soluble bismuth compounds in an oily vehicle, the irritating properties were overcome. Such compounds are now being tried; the double tartrate can now be bought. The employment of intravenous injection in almost toxic doses revealed an extraordinary effect on the kidneys and renal excretion resulting in a striking diuresis. This effect was studied and reported in the *Lancet*, August 12, 1922, page 328.

Cancer.—The use of diathermy for malignant conditions has, for some time, been recognized as efficacious. It was used in the surgical unit as a routine, both for the cure of superficial conditions and to replace the knife in all operations on cancer and sarcoma. Of 8 cases done during the last three months, 2 were discharged apparently cured. Cancer immunization has so far been done in 37 cases with some promising results. The difficulty of establishing a follow-up system, however, robs this method of treatment, as any other, of much of its value. The use of amniotic fluid in the treatment of inoperable cancer is also under investigation. It has been tried in 5 cases. These are still under treatment.

Milk Injections.—2 cases of undoubted septicæmia were treated with milk injections. Both cases were cured. 2 cases of inoperable carcinoma have also been treated in the same way, but further investigation is still necessary for arriving at any conclusions.

Blood Transfusion.—Blood transfusion in regard to deficiency diseases is now on its trial. A suggestive field has been opened by the complete restoration of carbohydrate tolerance for 21 days in a case of diabetes mellitus following the transfusion of whole blood.

Vasectomy for Senility.—This promises to enable the helpless aged poor to earn at least a partial livelihood. Unilateral vasectomy in cases of senility and debility without gross organic disease has been performed 17 times with encouraging results. In 1 case of senile chorea marked amelioration of symptoms was effected. Photographic records of patients are being carefully kept.

Butyn.—Butyn is a substitute for cocaine as a local anæsthetic. It has the following advantages over cocaine:—

(1) It is more powerful and acts more rapidly, and over a longer period than cocaine.

(2) *In the quantity required*, it is less poisonous than cocaine, and its cost is very little greater.

(3) It does not produce the same intoxicating

effect on the central nervous system and consequently does not possess attractions for the drug-taker. After employing it for a period of three months in close on 100 operation cases, it was found to be extraordinarily effective as an anæsthetic, either dropped locally into the eye, or in infiltration-anæsthesia. No toxic results had so far been noticed. A 2 p.c. solution has been used, 10 cubic centimetres of which cost P.T. .5·6 as compared with P.T. 5·2 for a 5 p.c. solution of cocaine hydrochloride, which is less effective as a local anæsthetic in ophthalmic work. Also smaller quantities of the solution were used in each case, so that the cost may actually be less than in the case of cocaine.

Anthelminthic Section.

The number of new cases sent to the section during 1922 was nearly one and a half times that of 1921. Of the total number about 12 per cent. are females and 20 per cent. children under 12.

About 20 per cent. of the patients sent to the section showed a negative result for helminthic infection on examination of the dejecta. Of the 80 per cent. positive cases, half the number completed the full course for bilharziasis and the other half received less than 10 injections. More or less irregularity in attendance is noticed in the majority of patients. The most regular in attendance are the children and women: of the men employees and students, specially those of El Azhar, are the best.

Bilharzia Division.

Specimens are collected for examination the first day of attendance and the treatment started the next day when the results are known. Negative cases which have symptoms and signs of other diseases, e.g., cystitis, or, in the case of intestinal disease, amœbic infection, are given appropriate treatment. As a routine measure, a re-examination of the dejecta is made at the time the penultimate injection (the eleventh) is given, and the result recorded. Should living ova still be found, extra injections are given—usually three—and the result again ascertained.

About 24 per cent. of the cases are unsuitable, i.e., show no ova or have severe cystitis which requires treatment before any underlying bilharzial infection can be safely dealt with. The ordinary course was sufficient in all but 0·5 per cent. Examination of the patients returning three to four months after a satisfactory course showed a complete cure had been obtained.

Drugs.—No difference was found between the sodium and the potassium antimony tartrate as regards their effect on the ova. For the patient the sodium salt is less toxic; vomiting and coughing are less than with the potassium compound. Also the sodium salt appears less irritative to the subcutaneous tissues, so that in some cases of escape from the vein very little inflammation followed and usually subsided under fomentations. In a few instances a sterile abscess was evacuated with a syringe. Nocturnal enuresis in children is sometimes an early sign of bilharziasis. Such cases were cured by antimony treatment. 1 case of cutaneous leishmaniasis in a girl was sent for treatment. The condition improved after 4 injections, when the patient ceased attendance, so that the effect of a prolonged course could not be ascertained.

Complications.—Cough and sometimes vomiting are the usual immediate toxic effects. Sometimes bleeding occurs from the strain; this is readily checked by rest and giving ice to suck.

One Death Occurred.—This was a girl of 14, who had received 8 injections without any symptoms. After the ninth she coughed a while and then felt better. She left the tent in a good condition, but in the same afternoon was brought to the hospital in a collapsed condition and died that night.

An epileptic boy was seized with a fit every time he was given an injection. He was admitted into hospital.

Emetine.—This drug is used for subcutaneous injection in children whose veins are too small for intravenous injections. In consequence of the claim made by a local doctor and published in a foreign journal of repute, that a daily dose of emetine (the maximum being 2 gr.) continued for 12 days will certainly cure bilharziasis without the development of toxic symptoms, this course was given to 2 adult men and a woman. The hæmaturia disappeared after 6 injections, but there were many living and few dead ova on examination of the urine. After the tenth injection a considerable proportion of living ova were still present, and following the next injection the patients complained of numbness in their hands and legs. This result confirmed all the hospital's previous work that it is not possible to shorten treatment if we aim at a cure and not a mere amelioration of an obvious symptom.

Bismuth.—Under treatment with soluble compounds of bismuth some mild cases of bilharziasis were cured, the ova being killed. More active infections were much less affected, and at present it does not seem that bismuth is a satisfactory substitute for antimony in this disease.

Ankylostoma Division.

1,241 patients were sent to the section for treatment under the tentative diagnosis of ankylostomiasis. The stools were examined on the first day of attendance.

The flotation method was employed in examination except in the case of liquid and blood-stained stools. The ankylostoma patients are the most unsatisfactory in their attendance. When possible anthelminthic treatment is given at their first visit, but this is often impossible owing to the late hour of arrival or the fact that they have recently had bad food. Such cases were told to come early the next morning fasting, but often the patients never returned.

Colonial Medical Reports.—No. 194.—Egypt (*continued*).

It is customary to give one treatment to negative cases and 2 or 3 to positive cases of ankylostomiasis; other infections receive appropriate treatment. The hæmoglobin and pulse-rate of every patient are determined before a vermicide is given. A marked rise is noticed in the hæmoglobin value under treatment when the worms are expelled, as is shown by the absence of ova in the stools on subsequent examination. Patients sent to the bilharzia division who are anæmic are not given the antimony course until their condition is improved by the expulsion of ankylostomes and the administration of hæmatinics.

Drugs.—Oil of chenopodium was almost the only drug used as a vermicide. It is put up in capsules of 0·5 c.c. Adults were given 4 capsules (2 c.c.) children 3 capsules, followed by a purge. Santonin and male fern are given for ascaris and tænia, respectively. Carbon tetrachloride is now under trial. At first it was given in doses of 6 c.c. (adult) or 4 c.c. (child) mixed with an equal dose of castor-oil. It is now being given pure in doses of 4 c.c. and 3 c.c. (children).

Alexandria Government Hospital.

General.

6,948 patients were admitted to the hospital, 5,562 males and 1,386 females. This is a decrease of 1,312 cases less than the number of admissions during the year 1921. With the addition of 297 cases remaining at the end of the year 1921 to the total number of admissions, we get a total of in-patients 7,245.

While the admissions have decreased, the out-patient cases are more than doubled.

The following factors explain to a great extent the diminution in the total number of admissions during the year:—

(1) The number of beds of this hospital is at present too small for the city of Alexandria and the environments which naturally drain here. During past years extra cases were allowed to lie on the top floor or were accommodated on the balconies, but such arrangements were found impracticable and were stopped. If there had been more beds more cases could have been accepted and the admissions would have shown a big increase.

(2) The outbreak of infectious diseases during 1922 was the mildest ever known. There was no need to open the Chatby Isolation Hospital as all the cases we received were easily accommodated in the infectious block of the General Hospital.

(3) No military cases at all were dealt with during the past two years, while they used to increase the general number of the takings-in.

(4) Admissions to the *harim* were stopped early in December due to the new buildings.

The 6,948 admissions mentioned before do not include the women that received treatment at the Lock Hospital for native prostitutes (formerly the ex-Austro-Hungarian Hospital at Muharram Bey, and at present at Gabbary).

The Lock Hospital for Native Prostitutes.

918 cases received treatment at the Lock Hospital during the year, as compared with 914 during last year and 1,057 during 1920. With the addition of 44 cases remaining at the end of the year, the total is 962.

The Lock Hospital used to be the ex-Austro-Hungarian Hospital at Muharram Bey, and was evacuated on December 1, 1922, and the patients were subsequently moved to Gabbary.

The following table demonstrates the nature and results of treatment of these cases.

Diseases.	Cured.	Transferred to General Hospital.	Total.
Syphilis	234	—	234
Gonorrhœa	280	—	280
Soft sore	107	—	107
Skin diseases	19	—	19
Relatives accompanying patients	19	—	19
Under observation (found non-contagious)	253	6	259
Total	912	6	918

Summary.

Cases existing at beginning of 1922	38
Cases admitted during the year	924
Cases discharged during the year	918
Cases remaining at end of 1922	44

The Anthelmintic Annexe.

A Short Note on the Treatment of Bilharziasis and Ankylostomiasis.

Bilharziasis.

As in the year 1921, the out-patients annexe looked after the majority of the bilharzia cases; the severe, complicated and debilitated cases, however, as well as policemen, soldiers and *ghafirs*, municipality labourers, &c., together with those patients coming from distant places, especially the women, had to be admitted for treatment into the hospital wards.

The total number treated during the year 1922 is 405, as compared with 481 during the year 1921. The patient is given every other day an injection of the tartar emetic. As most of the intestinal cases are usually complicated by other secondary and dysenteric infections and exhausted by excessive bleeding and gastro-intestinal disturbances, they have to be treated in hospital, whilst urinary cases predominate in the out-patients. Patients of all ages attended, the average being 12 to 35 years. The youngest was a boy of 4 years.

Most of these cases present a category of diseases, especially of the parasitic affections, i.e., ankylostoma, pellagra and dysenteries with splenomegaly, hepatic cirrhosis, urinary fistulæ, restal papillomata and the complications of their advanced stages. 26 cases of the 101 in-patients had pellagra and 16 had amœbic dysentery. In spite of the treatment being regularly and comfortably given, many of the patients stopped attending either after the fifth injection, at a time when improvement sets in, or at the eighth, and is probably

due to the severe reaction or other external influences.

A special form has to be filled up for every new patient showing the history, past and present, age, sex, &c., and the microscopical findings with the progress of the treatment. The specimen, whether urine, stools, or both, is examined microscopically before starting the treatment, and this is repeated after the second week and after the third week, and then, as a confirmatory control, some 10 days after the end of the treatment. Tartar emetic still holds its first position. A sterile 6 per cent. solution in distilled water is prepared in hospital for stock use. The dosage varies with age and constitution. A ½ gr. is the usual initial dose, especially in youngsters, these being usually increased to a maximum of 2 gr. Improvement is apparent after the seventh grain, but an average total of 17 to 21 gr. is usually necessary for a real cure to be attained. 12 gr. have effected a cure in a boy of 8. Emetine has been used in very few cases with the special advantage of controlling bleeding in chronic advanced cases.

Nausea, vomiting, irritative cough, rigors, insomnia, pains all over the body, anorexia, wasting and debility, are the general reactions experienced by the patients. A sense of dysuria is also noted. Stomatitis and diarrhœa, in course of antimony treatment are signs of danger, especially in pellagrins. It may be interesting to note that, in a straightforward early case, the more reaction a patient suffers the better result he will enjoy.

Ankylostomiasis.

As in preceding years, all ankylostoma patients were admitted to the hospital and looked after in the medical wards. 56 patients were treated during the year 1922 and most of them required treatment for one or more concomitant disease. Oil of chenopodium is considered the best and most effective vermifuge and has always been given the preference to any other anthelmintic. Thymol had to be given on a few occasions, when the oil of chenopodium failed to give a satisfactory result. 3 c.c. of the oil given in 3 successive doses, at 2 hours interval, repeated on the fourth day and the eight, if necessary, was the usual routine dosage for an adult. Thymol to be given in doses from 1 to 3 or 4 grm. according to the age and constitution of the patient. There were no deaths at all, as, out of the 56 cases, 15 were completely cured, 35 were considered relieved, and 6 were discharged unrelieved, due to their refusal to stay long enough in hospital. No alarming symptoms ever appeared, in fact, no untoward symptoms beyond giddiness, epigastric discomfort and whistling in the ears. Any number of worms have been expelled on the first day of treatment, and it is interesting to note that other worms, especially the ascaris, which is a very common concomitant, used to be voided as well. It was a rule to purge the patient before and after the administration of the vermifuge and fast him in between. The stools passed during the next 24 hours were then collected, emulsified, strained with gauze and examined. Some cases, though negative microscopically, contained worms, and *vice versa*, other cases, positive under the microscope, could not be made to pass worms. The results of treatment were always saisfactory; the patients usually gained in hæmoglobin, added body weight and felt great improvement.

Poisonous Plants.

The transport in the country for export of poisonous plants, such as henbane, colocynth, datura, &c., is controlled as far as possible. Only one new authorization has been issued during the year. A considerable amount probably escapes detection as it is transported by river or caravan. The quantities which have been legally sent from Upper Egypt to the ports of embarkation are as follows: 688 kilos. of colocynth and 5·500 kilos. of henbane.

Opium.

As in the past the cultivation of the opium poppy and the collection of the opium is entirely uncontrolled; it is quite impossible to state the quantity produced or how it is disposed of. In order to exercise any effective control it would be necessary to know: (1) the quantity of seeds sown; (2) the total area planted; (3) the number of plants allowed to mature; (4) the quantity of opium collected; (5) the percentage of alkaloids which it contains. According to various analyses which have been made in the public health laboratories, it has been found that the morphia content varies from 3 per cent. and in some cases as much as 15 per cent. has been found. The strength depends to a large extent on the district in which the opium has been grown. The total quantity of opium imported during the year is 9,555 kg.; according to the registers of authorized poison dealers, this quantity has been re-exported to adjacent countries by sailing boats or by caravan. With regard to the opium produced in Egypt, it is known officially that 1,395 kg. have been transported under authorization, of which 665 kg. have been disposed of by authorized persons and 730 kg. by the cultivators on their own account.

STUPEFACIENT DRUGS (COCAINE, MORPHINE, HEROIN, DIONINE AND CANNABIS INDICA).

Although the new law has been successful to a certain extent in limiting the importation of stupefacient drugs for medicinal use to the actual needs of the country, it is certain that contraband traffic is still being carried on to an enormous extent.

Since 1920 the imports of cocaine have been steadily increasing every year; a fluctuation in the quantity of morphine increasing in 1921, and decreasing in 1922; an enormous increase in the quantities of heroin and dionine, namely, from 4 to 39 kg. and from 6 to 8 kg., respectively. Taking into consideration the large quantity of cocaine imported in 1922, namely, 155 kg., the figures show a large increase generally in the imports of the most

dangerous habit-forming drugs. It is to be regretted that the abuse of heroin and cocaine is facilitated by certain doctors over whom the pharmacy law has no jurisdiction. It is very probable that if steps could be taken to prevent these doctors writing prescriptions *ad libitum* for these drugs the consumption would decrease considerably.

Clinical Section.

Glaucoma.

The number of cases of primary glaucoma examined during the year 1922 was 2,512, or 1·7 per cent. of the total number of new patients presenting themselves for treatment. This number included 1,968 cases of absolute glaucoma in one or both eyes. The operation performed was usually Elliott's operation of trephining the corenosclera combined with iridectomy through the trephine hole; 503 operations were performed. In 466 operations, including those in which, owing to lenticular opacity, extraction would have to be performed sooner or later, iridectomies were performed. In the report for the year 1913 was mentioned: "the operation can and should be performed for a patient on an unaffected eye, as soon as the fellow eye has been definitely diagnosed as glaucomatous, since the operation is almost devoid of risk, and early operation is prophylactic against the development of increased tension, glaucoma usually affecting both eyes sooner or later." This policy has been religiously adhered to during the last ten years, and there is no reason to alter this opinion. Secondary infections are extremely rare in Egypt, only 17 cases having been reported since 1911 out of 5,017 operations of trephining performed during this period.

The extraordinary difference in the incidence of secondary infection between experiences in Egypt and the experience of some European surgeons must have its origin in one of four causes:—

(1) Defective inspection of post-operation cases in Egypt; the patients developing much more secondary infection than one has knowledge of, but refraining from presenting themselves at hospitals. (2) The texture of the conjunctiva of the Egyptians being of a more resistant nature than that of Europeans. (3) The technique used being of a more adroit nature than that in Europe. (4) Greater liability to endogenous infection in Europe than in Egypt. It is impossible to form a definite opinion at the present time on this important matter.

It must be remembered that the cases here considered were all hospital patients, who instantly agreed to whatever operative treatment was proposed by the hospital surgeon, a very different state of affairs to that obtaining in Europe among glaucoma patients.

Cataract Operations.

The operation of election in the 641 extractions of senile cataract performed during 1922 was the combined operation of extraction with iridectomy. In certain cases of complicated cataract a preliminary iridectomy was performed. Loss of vitreous is an exceedingly serious event in the operation and one to be avoided by every means in the power of the operator, as in such a large number of cases detachment of the retina occurs either as an immediate or as a delayed sequela of the operation. The average of vitreous loss for 33 operators of 6·8 per cent. seems to be not excessive as compared with the results published by those surgeons in other countries who go in for what may be called the more fancy operations. It must be remembered that some of our surgeons are very junior, also that complicated operations are more frequent than in England, owing to the effect of trachoma and acute ophthalmias. A selection of the operation which best suits the operator, which can be performed in the minimum time with the minimum disturbance of the tissues, and which is least likely to be followed by loss of vitreous is obviously the best line to take. The six months, June to the end of November, corresponding to the warmer months of the year, are those in which the amount of clinical work is at its maximum.

Acute Ophthalmia.

The importance of applying treatment as soon as an attack of acute ophthalmia appears is, of course, self-evident. Frequently, however, the patient defers coming to the hospital until ulceration of the cornea has already developed. In these cases whatever may be the bacteriological cause of the condition, the local treatment is the same, thorough swabbing of the conjunctiva of the everted upper and lower lids with silver nitrate 2 per cent. in the morning (and again in the evening in all severe cases, taking care, however, not to cause excessive necrosis of the superficial epithelium). Constant washing of the eyes by the patient himself under supervision, with, if possible, occasional irrigation of the conjunctival sac by the surgeon, with ordinary surgical eusol solution is to be used. If, owing to the weather or other conditions, the eusol cannot be utilized at its full strength, potassium permanganoate solution of a strength of 1 in 5,000 should be used. A very small percentage of patients who come under treatment before ulceration develops, suffer any damage to the cornea. The organisms most frequently found were in the following order (in cases in which the cornea was ulcerated) pneumococcus, mixed infection, gonococcus, Morax-Axenfeld bacillus, Koch-Weeks bacillus.

Membranous Conjunctivitis.

Membranous conjunctivitis is not uncommon in Egypt, especially during the warmer months. Up to the present time microscopical examination of the conjunctival discharge with an oil immersion lens has always failed to show the presence of organisms other than the gonococcus, the Koch-Weeks bacillus, the pneumococcus, the staphylococcus, the streptococcus, Morax-Axenfeld or Xerosis bacillus. During August and September of the year 1922, however, a diphtheritic condition being suspected, material was sent up to the Public Health Laboratories in order that cultures might be

made. In a certain number of cases the results were positive and warning having been issued to all hospitals, special precautions were taken to prevent the spread of this dangerous condition. A *résumé* of this subject only can be given here. The organisms in twenty-two cases were reported from the Public Health Laboratories as having been shown after culture to be identical in morphological features with the Klebs-Löffler bacillus. And by exhaustive animal experimentation four of these twenty-two cases were proved to have been actually caused by this organism. It is, of course, clear that time would not allow of more than four cases being subjected to the necessarily prolonged investigation required by modern bacteriologists for the complete proof of the nature of the organism as being actually the Klebs-Löffler bacillus causative of diphtheria. One or two points stand out as certain from recent experience. It is quite impossible on clinical grounds to state whether or not a case of membranous conjunctivitis is due to the diphtheria bacillus or not. Another equally important point is that microscopical examination with an oil immersion objective of a stained film of the conjunctival discharge is without importance as regards an exact diagnosis. In several cases in which animal experimentation fully showed that the condition of infection with the bacillus diphtheria was present, a careful examination of the discharge only showed the presence of an organism resembling the gonococcus, the Koch-Weeks bacillus, &c.

Infectious Diseases.

Typhus and Relapsing.

The reduction in the number of cases of the principal infectious diseases noted as having begun in the year 1920 has been continued in 1922 as regards typhus and relapsing fever. Thus in 1922 only 170 cases of relapsing fever were recorded, as against 1,217 in 1921 and 2,876 in 1920. This is the smallest number recorded during the last ten years.

The diminution in typhus fever has been much more marked. Only 2,484 cases were recorded in 1922, as against 4,476 in 1921. This, too, in the case of this disease is the smallest number recorded during the last ten years.

The diminution in these diseases is very satisfactory. As stated in last year's report, some part of this reduction may be attributed to increase in knowledge among the populace of the part played by the louse in the dissemination of these diseases and to the considerable improvement in the methods of delousing.

Small-pox.

Although the number recorded during 1922 (305 cases) exceeded that which occurred in 1921, yet it is satisfactory to note that this number is far less than the number of cases which occurred in any of the 20 years previous to 1921. This is due to the general vaccination referred to in last year's report, which campaign was begun in 1919 and finished in 1921. Nearly all the cases which occurred in 1922 had escaped vaccination during the general vaccination campaign. 203 cases out of 305 total occurred in Girga Mudiriya and consequently the whole Mudiriya has been revaccinated.

Plague.

The total number of plague cases in 1922 was 487, as compared with 256 in 1921. The number of deaths in 1922 was 228, showing a mortality of 46·8 per cent. The death-rate in 1922, although higher than in 1921, is low when compared with previous years. Of the 487 cases which occurred in 1920, 448 cases were bubonic, 10 pneumonic, and 29 septicæmic. Thus the proportion of pneumonic cases to bubonic was 2·20 per cent. Of the 487 cases 193 cases occurred in the ports, i.e., 71 cases in Alexandria, 54 cases in Port Said, and 58 cases in Suez. The remaining 304 cases occurred in the interior. Of these, 60 occurred in Tanta in a village called Birma.

Malaria.

The amount of malaria in the country was normal. The number of malaria cases notified during the year 1921 was 2,012, and during the year 1922 1,078.

Influenza.

There was no serious outbreak of influenza. The type was mild. The number of cases notified during 1922 was 4,493.

Antirabic Institute.

In 1922, a total of 2,411 cases of bites were reported to the institute. From this number the following deductions should be made: 933 persons not treated at all, the biting animal was found by the Veterinary Service to be non-rabid. 5 persons who ceased to attend for treatment without a satisfactory reason. 121 persons whose treatment was discontinued as being unnecessary, the observation of the animal for a period of ten days or more having shown it not to be rabid. 2 persons whose treatment, although completed, must be considered useless, the animal inflicting the bite having been proved healthy by inoculation of rabbits. The statistics, therefore, comprise 1,350 patients. This figure is an increase of 190 over the number treated in 1921.

Notes on the Animals Inflicting the Bite.

(1) It is to be noted that the number of persons bitten does not correspond to the number of the animals causing the bites reported by the veterinary service, as in several cases one animal caused the injury to more than one person.

(2) As a result of their observation by the veterinary service, 1,050 animals, having bitten 1,054 persons, were found to be non-rabid.

(3) Experimental inoculation of rabbits undertaken at the institute showed, up to the present, that two animals, having bitten two persons, were healthy (some rabbits inoculated are still under observation).

(4) In a certain number of cases, definite diagnosis could not be established, and these cases are considered as suspect. The details are as follows:—

558 animals escaped and could not be found.

70 animals were killed and the carcase destroyed.

175 brains of animals arrived at the institute in a state of decomposition and no investigation was possible.

49 animals remained suspect, the rabbit inoculated being inconclusive.

The total of suspected animals is therefore 852.

(5) Rabies was considered to be proved in the case of 51 animals having bitten 123 persons. The diagnosis was determined:—

By the veterinary inspectors in the case of 9 animals (7 dogs and 2 donkeys) having bitten 17 persons.

By rabbit inoculation in the case of 42 animals (39 dogs, 1 cat, 1 donkey and 1 rat) having bitten 106 persons.

(6) In the case of 15 animals, having bitten 44 persons, positive diagnosis of rabies is presumed by the death of one or more of the patients bitten.

Method of Treatment.

From July 1, 1922, and after the occurrence of a case of death which took place under doubtful circumstances, and which may expose the method of treatment to criticism, the treatment was modified as follows: emulsions are heated for 20 minutes at 56° C. in a bain-marie. This temperature, according to the experiments of Babes, and then carried out in our Antirabic Institute, is sufficient to attenuate the virus of rabies, but not to sterilize it so that it will be harmless when inoculated subcutaneously. The result of treatment during the next year will show if this procedure gives as satisfactory results.

Colonial Medical Reports.—No. 195.—Sierra Leone.

ANNUAL MEDICAL AND SANITARY REPORT FOR THE YEAR 1924.

PUBLIC HEALTH.

General Remarks.

The general health of the European community may on the whole be considered satisfactory. The invaliding rates per 100 residents was 7·92, as compared with 13·72 for the previous year.

Malaria was, as usual, the most common individual cause of sickness. Sixty-one among in-patients and fifty-eight out-patients in a total of 152 and 395 cases, respectively.

There is an increase of 6,938 of total new cases treated, 248 more in-patients and 6,690 more out-patients. This increase does not mean that the amount of sickness was greater, but that an increasing number of people appreciate the benefits of European medicine. An even more satisfactory feature is the large increase (30,091) in the number of subsequent attendances. It is always difficult to persuade patients to continue treatment after the first symptoms have subsided; and that the difficulty is being overcome shows an increasing faith in treatment, the result not of hearsay but of personal experience of the benefits to be obtained.

Sierra Leone was free from any epidemics throughout the year.

Communicable Diseases.

Dysentery.—A total number of 475 cases, showing an increase of 175. These figures need not be taken too seriously, as a very large proportion of the total number is returned from out-station dispensaries where the diagnosis is made by the dispenser on clinical symptoms only.

Tuberculosis.—The number of cases treated shows a slight decrease, but there can be no doubt that this disease is becoming increasingly prevalent. The increase in the number of subacute cases points to the fact that the disease is becoming established here. A departmental committee has been appointed to consider what steps can be taken for the control and treatment of the disease. Meanwhile, in the case of Freetown, the registrar of births and deaths informs the medical officer of health of all deaths returned as due to tuberculosis; the premises are then inspected and disinfected and advice given *re* overcrowding, &c.

Venereal Diseases.—Both gonorrhœa and syphilis show a considerable increase in the number of cases presenting themselves for treatment, but this probably indicates a greater faith in modern treatment rather than an actual increase in the incidence of the disease.

Malaria.—There is a small increase of 457 in the number of cases treated—3,492, against 3,035 for 1923. The deaths from malaria were 12, or a case mortality of 0·34 per cent.

Blackwater Fever.—There were 7 cases during the year with 1 death.

Trypanosomiasis.—2 cases only were reported.

Leprosy.—25 new cases were reported during the year. Of these, only 5 could be persuaded to submit to any treatment, and all these 5 absconded

after only one injection of moogrol or gorli seed oil. One nodular case remaining from 1923 continued to do well on moogrol.

Ankylostomiasis.—This invasion is general throughout the Colony and Protectorate. Each medical officer submits an annual special report on this disease.

Preventive Measures against Insect-borne Diseases.

Malaria.

The following is taken from the report of the medical officer of health, Freetown:—

House-to-House Inspection.—100,656 inspections of houses and compounds were carried out during the year, 353 mosquito breeding places being found. 353 prosecutions followed with 314 convictions. Total fines amounted to £77 10s., an average fine of 4s. 11d. per case.

Mosquito Breeding Places.—The total number of mosquito breeding places discovered and dealt with was 796.

Closing of Wells.—One well, the existence of which was only discovered during 1924, was closed by the Public Works Department.

Cesspools.—Disinfection of cesspools was carried out during the dry season and 11,057 cesspools were oiled during the rains.

Canalization of Streams.—Alligator, Sanders and Nicoll's brooks were regulated and canalized towards the end of the year and all mosquito breeding pools, &c., were obliterated.

Oiling of Pools and Gutters.—79,886 pools and gutters were oiled by inspectors in charge of sections and 31,708 by the oiling gang, which operated for six months of the year. Total 111,594.

Inspection of Trees.—32,440 trees were inspected during the year and 20,495 holes likely to hold water were discovered. 13,372 of these holes were cemented and 7,123 were cut so as to prevent water lodging there. 319 mosquito breeding places were found.

Inspection of Boats and Canoes.—6,547 boats and canoes were inspected for stagnant water and 2,159 were oiled.

Drainage.—Drainage work was carried out by the sanitary engineer and existing drains improved.

Trypanosomiasis.

Two cases were seen; clinically they were typical of the disease, but in neither case was the trypanosome found nor was a post mortem obtained.

(*i*) The case was admitted to the wards from out-patients; the diagnosis was clinical and not confirmed by the laboratory. The relatives gave a history of several months fever and drowsiness. The patient presented a typical picture of late trypanosomiasis, there was evidence that there had been extensive cervical adenitis and a good amount of scarring, the result of native treatment. Extreme lethargy and nervous tremors completed the picture.

(*ii*) Patient admitted to the male infirmary on July 4, sent from Freetown with a provisional diagnosis of trypanosome infection. There were enlarged glands in the neck and he was wont to go off to sleep at all times. The blood examined on several occasions, but no trypanosomes were seen. The glands were not punctured. He had a history of having been in the Congo.

During the year further work was done by prison labour at Cape Sanitary Station, a further extent was cleared and planted with Efwatakala grass. At the end of the year more than half the peninsula was completely cleared, and half this cleared area well planted.

Relapsing Fever.

No case was reported during the year. All medical officers in out-stations had special instructions to be on the look-out for cases, owing to the outbreak in Nigeria, Gold Coast and Fresh territory; special endeavours to find cases in Freetown gave no results.

Preventive Measures against Infectious and Epidemic Diseases.

Cerebro-spinal Meningitis, Influenza.

No cases of cerebro-spinal fever or influenza were reported.

Plague.

No cases were found during the year. 12,708 rats were brought to the department and destroyed; these were paid for at the rate of 1d. per head. A systematic examination of rats for *B. pestis* was commenced at the end of November at the laboratory of the medical department. No infected rats were found.

From March till the end of the year the Gold Coast was infected with plague and, for the last four months of the year, Lagos. Practically all deck-hands of the ships are recruited and discharged in Freetown. This entailed rigid supervision of every homeward bound ship calling here, quarantining all deck-hands and deck-passengers who had been in an infected port within the specified time and disinfection of their belongings. The sanitary departments of the Gold Coast and Nigeria are to be congratulated on the excellent preventive measures adopted and so effectively carried out.

Small-pox, Chicken-pox, Vaccination.

Sierra Leone was unusually free from small-pox during the year. Two suspicious cases were diagnosed as doubtful and treated as small-pox in the Infectious Diseases Hospital. In the Protectorate 10 cases were notified, one at Kumrabai Mamilla (Bambali District), 6 in the Imperri chiefdoms (Gbangbama District) and 3 at Kaiyima (Konno District). Chicken-pox was frequently reported in various parts of the Colony and Protectorate.

Owing to the abolition of specially appointed vaccinators in the Protectorate, the number of vaccinations during the last two years shows an apparent falling off. Vaccination is now being carried out more efficiently and under close supervision by sani-

tary inspectors and dispensers, and every effort is being made to increase the amount done.

Dysentery.

According to the reports from the Connaught Hospital there would appear to be a great apparent reduction, i.e., 42 cases in 1924, as against 138 in the previous year. Practically speaking this disease is now negligible in Freetown.

Tuberculosis.

It is the general opinion that tuberculosis is very noticeably on the increase in the Colony. Towards the end of the year a committee was formed to report on the prevalence, spread, &c., and to suggest means of dealing with same, to report, *inter alia*, on the advisability of rendering it a notifiable disease. Up to the end of the year the report was unfinished.

Anthrax.

There were 4 cases of anthrax in animals discovered during the year, diagnosis being confirmed by bacteriological examination. No human cases were found.

Measles.

Two cases of measles were admitted to the Infectious Diseases Hospital during the year.

Other Diseases.

Diphtheria was not seen during the year. Sporadic cases of whooping-cough were seen, no epidemic was reported.

Port Sanitary Work, Freetown.

The port was in quarantine during the year. All ships arriving from infected places were examined by the medical officer of health and, when necessary, action taken.

Owing to the numerous places infected with plague, &c., the port sanitary work was greatly increased; the crew and deck passengers of all ships coming from a plague-infected port were individually examined. This entailed an amount of extra work on the medical officer of health, who is also port medical officer, and on several occasions his whole day was spent on port work. In Freetown the ships anchor in the river at various distances from the bank, and, although there is no surf condition as is experienced further down the coast, yet when the weather is rough and the current is strong it has taken forty minutes to one hour to get alongside a ship lying far out. Sometimes the only means of getting on board or leaving the ship is by climbing a rope ladder—no pleasant matter during torrential rains, high wind, and with a six-knot current running. The medical officer of health has been known to have been completely ducked in the river, and I have several times seen his clothes ruined with grease, tar and oil. Once I had a request that the department should buy him a new suit. Outside the department it is not realized what an unpleasant, arduous and often dangerous job ship-boarding is here. The provision of a motor-boat for the port medical officer is absolutely essential, unless the question of appointing another officer for this work, other than the medical officer of health, is considered.

Measures taken to Spread the Knowledge of Hygiene and Sanitation.

The usual courses of lectures to sanitary learners in connection with the syllabus laid down in the regulations were given by the medical officer of health. These courses were also taken by male nurses in training at the Connaught Hospital. Sanitary learners also receive instruction in office routine, outdoor sanitary work in all its branches, police-court duties and so on, under the observation of the medical officer of health and superintendent sanitary inspectors.

The death-rate of 25·9 per 1,000 in Freetown in 1924 compares with a rate of 30 per 1,000 in 1923, the actual number of deaths being 1,332 in 1923 and 1,143 in 1924. There was an increase in the number of births registered from 853 in 1923 to 982 in 1924, but in spite of the efforts of the registrar's officer, assisted by the sanitary staff, registration of births must still be regarded as incomplete.

Connaught Hospital and Laboratory Report.

During the year 2,258 specimens were sent for examination.

Nursing Home and Connaught Hospital.

Blood Infection.—644 samples were examined, chiefly from cases of suspected malaria. *Plasmodium falciparum* was found on 173 occasions, *P. vivax* accounted for 12 cases and *P. malariæ* for 9. Malaria was specially prevalent during the months of April, May and June, and during this period only were sexual forms of *P. falciparum* found in films from adult natives. Of the blood microfilariæ, *Filaria bancrofti* was found on 7 and *Filaria loa* on 4 occasions. Chemical, microscopical or spectroscopical examinations were made of 267 specimens of urine. 130 specimens of sputum were examined, in 31 of which *B. tuberculosis* was found. This bears out our clinical observation that tuberculosis is increasing in Freetown. 46 specimens of pus, chiefly from cases of venereal disease, were examined. 3 cases of leprosy were diagnosed from microscopic findings during the year.

Helminthic Infection.—The high percentage of specimens showing infection with ova or larvæ of various helminths is still maintained, the most common parasite being *Ascaris lumbricoides*. Slightly less common are *Ankylostomidæ* followed by *Trichuris trichiura*, *Strongyloides stercoralis* and Tæniidæ. *Oxyuris vermicularis* is very uncommon. 503 specimens of fæces were examined, Many of the cases show infection with more than one parasite, the most common association being ascaris with ankylostoma. 2 cases had infection with 4 different varieties of ova. *Entamœba histolytica*, either encysted or in free forms,

was found on 38 occasions. Of the non-pathogenic amœbæ, *Entamœba coli* is most commonly found followed by *Iodamœba butschlii* and *Endolimax nana*. Of the intestinal flagellates, *Lamblia intestinalis* is found most frequently, in the majority of cases, associated with clinical dysentery.

Miscellaneous.—A daily examination has been made on rats caught in different localities in Freetown. Smears from the spleen and glands are made from each animal and so far no infection from *B. pestis* has been found. Cases of poisoning from impurities present in carbon tetrachloride have been recently reported from various countries. Periodical chemical tests of samples of this drug from the dispensary have been made to detect the presence of carbon bisulphide. Samples so far examined have been free from this impurity and no ill-effects have been seen from the use of this drug in the wards. The usual dose employed is 1 dr. repeated after one day's interval. Several slides from suspected cases of anthrax in cattle were examined. Sections of several tumours were made for purposes of diagnosis.

Notes on a Mosquito Survey at Daru, Sierra Leone.[1]

I.—*Introduction.*

This survey was carried out during the period September 17 to 28, 1924, that is at the end of the rainy season. The maximum temperature recorded during this period was 83° F., and the minimum 69° F.

The investigation was primarily directed to the discovery of mosquito, especially anopheline, breeding places, and secondarily to evolving methods by which the breeding places could be eradicated or controlled. Questions of general sanitation, e.g., water supply, housing, conservancy and refuse disposal, were also gone into as far as was possible in the limited time available, but are omitted from this extract from the original report.

II.—*Description of the Cantonment.*

The cantonment is situated on slightly raised ground on the right bank of the River Moa. There are two sets of officers' quarters with the officers' mess situated between them. One set of the officers' quarters and both the headquarters and A Company lines face the River Moa, the other set is situated higher up above the valley from the hospital to Swamp A. Just above the barracks is the railway bridge over the river, and beyond the bridge at a distance from it of about 200 yards is a creek which forms the outlet into the river of the swamp. Some distance below the barracks is a second creek which forms the outlet into the river of the second swamp. The two swamps A and B arise at a common watershed situated behind the barracks and pass above and below it, skirting it to reach the river. The barracks are therefore almost completely encircled by river and swamp. It will be seen later that certain streams which are feeders of these swamps and of the river arise actually in the barracks grounds.

At the time of this examination, the river Moa had arisen and overflowed its banks in front of the officers' quarters and part of the men's lines; the level reached by the water was stated to be higher than it had been during the previous eight years. The rise in the river level was accompanied by a corresponding rise in the level of the water in both the swamps A and B and in their branches and feeder streams. It was at once evident that if anopheline mosquitoes were breeding at the edges of the river and swamps, the process of flooding must inevitably bring them into much closer proximity to the houses, especially to those occupied by the officers.

III.—*Mosquito Survey.*

(*A*) *Breeding Places. Mosquito Traps.*—27 water traps put down in various sites in the camp, but of these 5 were discarded owing to accidents. 22 remained; of these 22, there were 9, that is 41 per cent., which had mosquitoes breeding in them. Of these 9, 8 contained only culicine larvæ, while 1 contained both culicine and anopheline larvæ; in several cases larvæ belonging to different broods were present in the same trap. While this experiment demonstrated the very general prevalence of mosquitoes around and in the barracks grounds, it proved in the end only of confirmatory value, because while it was in progress the direct discovery of breeding places had already revealed a somewhat disturbing state of affairs.

The Moa River.—The bank of the river was examined from the creek above the railway bridge down to the creek beyond A Company lines. For the sake of clearness in description this stretch may be divided into sections.

Section I extends from the creek above the railway down to the bridge. The bank was several feet high in parts of this section, but in other parts it sloped gradually down to the water; in all this section it was covered with thin bush or coarse grass. Along the edge anopheline larvæ and pupæ were found in fair numbers.

Section II extends from the railway bridge to the end of the area occupied by the officers' quarters. Along this section the bank was grass covered and sloped gently down to the water's edges. In the margin of the river throughout this section anopheline larvæ and pupæ were numerous.

Section III extends along the front of headquarters lines. In this area the river bank is high, being 8 ft. to 12 ft. above the water; the water runs along bare soil with no shelter for mosquito breeding purposes. No anopheline larvæ or pupæ were found here.

[1] These notes form part of a report presented to the Government of Sierra Leone.

Colonial Medical Reports.—No. 195.—Sierra Leone
(continued).

Section IV extends along the front of A company lines. This area has banks which slope gradually down to the water's edge; in this respect it resembles closely Section II. No anopheline larvæ or pupæ were found here. The reason for this appears to be that in this section opposite A company lines, the bank had been completely denuded of grass and weeds. This simple alteration in the character of the bank is apparently responsible for the important difference in anopheline breeding. Thus the river's edge in Section II yielded on September 17 over 150 anopheline larvæ and pupæ, while the river's edge in Section IV on the same date yielded none.

Section V extends from the far end of A company lines at the end of the barracks ground to the creek below. The bank here was bushy and flat, and larvæ and pupæ of anophelines were present in fair numbers.

If we turn attention more particularly to the three sections which lie immediately opposite the barracks we note several points of interest. Section II, for example, grass-covered and with a gentle slope affords excellent breeding shelter for anophelines when the water in the river is low; as the water rises the gentle slope of the ground permits the water to encroach nearer to the officers' quarters, and as it rises it brings with it the larvæ and pupæ already bred in it; in addition, it forms grassy pools in which both anophelines and culicines lay their eggs. Section III has steep banks and when the water is low it affords little shelter for anopheline breeding. Even when the water rises it is still confined by the bank and no breeding places are formed.

A factor which has a secondary influence in Sections II and III arises out of the configuration of the river at these points. The bank of Section II is concave towards the river, while that of Section III is convex. The result is that the water which spreads out and is sluggish in flow at the edge of Section II is restricted and more rapid in flow along the edge of Section III.

Section VI, of which the bank is sloping but bare, affords no shelter for anopheline breeding. Hence when the water rises here it does not bring with it larvæ and pupæ. Furthermore, as the whole of the bank even above high water mark is bare, no grassy pools are left in which anophelines and culicines can breed when the river recedes.

The detailed study of these three sections, therefore, reveals important factors bearing on the bionomics of the river bank anophelines. It will be observed that advantage can be taken of the information so obtained in such a way as to eliminate anopheline breeding places in those sections where they are at present found. The remedial measures which may be used to accomplish this most economically will be discussed later.

There are several additional facts which must be taken into account while dealing with the river.

(*a*) *Tributary Streams.*—Several small irregular water courses, partly from springs, partly from surface drainage, run down to the river from higher ground upon which the barracks are situated. One of these deserves special attention. It is that stream which lies between headquarters lines and A company lines. This stream has clear water derived from a spring on the high ground; it has in it and at its edges a considerable quantity of grass and weed. As it passes down it spreads out on approaching the river, and in this part it is heavily fringed with grass. In the lower part of this stream anopheline larvæ were found.

(*b*) *Fallen Trees.*—Along the edge of the river several trees have fallen into the water; many of these have large holes in them which the river water fills when the river is high. Owing to the excessive height of the water at the time of this visit the holes were flooded out by the river. It is more than probable, however, that as the river recedes the holes which retain water, many of them of large size, will act as breeding places for mosquitoes.

(*c*) *Rocks.*—As the river falls a reef of rocks is exposed to the centre of the river, and rocky pools are left in large numbers. It is almost certain that these pools will breed mosquitoes.

Swamp A.—This swamp was followed from the mouth of the creek by which it enters the river above the railway bridge to its source behind the barracks at the back of Boma town; anopheline and culicine larvæ and pupæ were found in large numbers along its whole length. The character of the swamp changes as it passes up towards its commencement. Where it lies on the far side of the railway it is deep and has strong bush growing along its margins. Soon after crossing under the railway it becomes shallower, and in its upper part it is covered with a matting of coarse grass. It was possible at this point to walk over it, but each step left a pool of water from which larvæ and pupæ of anophelines were almost invariably recovered.

The Hospital Drain.—In passing upwards along the Swamp A from the creek it was observed that a drain leading from the hospital joined it by passing under the railway. It was found that the ground just inside the railway on the way to the hospital was marshy, and that in this marshy ground anophelines as well as culicines were breeding.

The drain from the hospital on the high ground comes down a steep hill, and then flattens out and passes with a gradual slope in the railway embankment, under which it passes to join Swamp A beyond the railway. The condition of the drain at the time of examination was as follows:—

" Owing to the rise of the swamp water the culvert under the railway was full to the top. The water of the drain had overflowed the edges and a large triangular area of ground was rendered swampy. As a result of the rise of the swamp water, therefore, the drain was no longer able to carry away the water from the hospital area. On the contrary, water from the swamp had passed up

along the drain to a point midway between the railway and the hospital. In the water thus carried up anopheline larvæ and pupæ were present; these came from the marshy triangular area at the railway and probably also from the swamp beyond the railway. This drain then, as now laid, is not effective in carrying away water at times when the river is high; not only so, but it acts as an easy route by which anophelines may be brought right into the heart of the barracks grounds, to a position where they could not exist if this drain were not there. The danger of this anopheline breeding place and the drain can best be emphasized by pointing out that several officers' houses are within 100 yards on one side, while the hosptial and British non-commissioned officers' houses are at a similar distance on the opposite side."

Swamp B.—This was followed from the creek by which it opened into the river upwards to its source beyond the rifle range. Anopheline larvæ and pupæ were found along its margin, but by no means in such large numbers as was the case in Swamp A. At one point this swamp has close relationship to the barracks. Outside the barracks grounds is a feeder stream which runs to Swamp B. This stream is very difficult to approach owing to the dense growth of bush and grass which covers it. Yet in it, within 150 yards from the nearest house in the barracks, numerous anopheline larvæ and pupæ were found. This is the nearest point to which the waters of Swamp B approach the barracks.

Mosquito Breeding in the Barracks Grounds: (*a*) *Artificial Water Containers.*—The tanks which receive roof water were examined for larvæ and pupæ. The roof gutters of the hospital sagged in places and afforded a lodgment for water; this was also searched; in neither case were breeding places found. A wooden mortar standing beside the river at the women's washing place contained a little water; this was seething with larvæ and pupæ of culicines. A pail of water standing at the place where the latrine buckets are emptied contained culicine larvæ and pupæ. Apart from these two isolated and remote instances, no artificial containers were found breeding mosquitoes. The whole barracks grounds were commendably free from derelict tins, bottles and other objects capable of harbouring mosquito larvæ.

(*b*) *Wells.*—There is only one well situated in the mess grounds. This is about thirty feet deep and is in rock; it is disused; it contained only a few inches of water; in this culicine larvæ were found.

(*c*) *Trees and Shrubs.*—The large number of trees and shrubs in the ground at Daru is quite a feature of the landscape; especially in the neighbourhood of the officers' quarters and the officers' mess. While some of the trees are of economic value, by far the majority are purely of æsthetic value. Although, as will be shown below, many of these form breeding places for culicine mosquitoes, it would be very unwise to adopt any panic policy with regard to them; the value of good trees for shade purposes is very considerable, and there is no necessity to take steps which may later be regretted. If the regular routine inspection and treatment which is recommended later is carried out, it should not be necessary to sacrifice a single useful or ornamental tree.

The investigation of breeding places in trees and shrubs was carried out in a systematic manner; it proved no easy task, but great assistance was obtained from natives employed. These were first of all trained in their duties; each tree and shrub was carefully examined for holes which might contain water; if such a cavity was found, a piece of native string was tied to the shrub or tree. Any which actually contained water were marked by a second string. In two days four men had marked in this way all trees and shrubs found capable of, or actually containing water. When they reported their task finished a rapid survey was made of all unmarked trees and shrubs; in surprisingly few cases had possible breeding places been overlooked. Attention was next turned to the marked ones, and each water collection was in turn carefully examined for larvæ or pupæ of mosquitoes. In this way a large number of breeding places was discovered and each was dealt with or else marked in a permanent manner in order that it might be radically treated.

It should be observed here that no instance of anopheline breeding in such places was found. This corresponds with the results obtained by Bacot in Freetown in 1915, and also with those at present being obtained by the sanitary department there in their survey of trees. It is true that Bacot found one breeding place of *Anopheles costalis* in connection with a tree. This was a pool formed on the buttress root of a silk cotton tree at ground level; it was simply a pool of water lying on the unbroken bark; it would appear to be analogous to a rock pool and not an instance of a true tree-hole breeding place.

In the ground of the officers' mess alone forty-two collections of water were found in holes of trees, in tree forks, in leaf axils and in shrubs. Of the forty-two collections of water thirty-three contained larvæ and pupæ of mosquitoes. Nearly two-thirds of the breeding places were in the clumps of bamboo near the tennis court. Many of these had been cut in such a way as to leave a little tube containing water above the point. Most of these breeding places were dealt with at once while making the survey.

In the grounds generally breeding places were found in all clumps of banana examined, either in rotten stems or in the healthy trees in the wet clefts between the petioles. Pineapple plants provided many breeding places. Large trees were found to breed in collections of water in the forks, and in rot holes where branches had broken off or been cut. Much more frequently, however, breeding places were found near the ground level, on exposed roots.

(*B*) *Adult Anophelines.*—The preliminary survey of the river and swamp waters had shown that anopheline breeding was going on all round the

cantonment and in feeder streams arising in the barracks grounds. The survey of trees and shrubs had shown that while culicines were breeding in such sites in the barracks, anophelines were not breeding there. Search was next made for adult anophelines. (*i*) *Officers' Quarters*: Examination of the officers' quarters showed that *Anopheline costalis* were entering the barracks to feed, they were present in small numbers in the quarters. *Anopheline nili*, although breeding on the river margin close to the quarters, was not found in them. (*ii*) *Native Houses*: Adjacent to the first house of the officers' quarters is a house occupied by the family of a native servant. On several days in succession adults were searched for here, and were always captured in considerable numbers. Over 100 fed females of *A. costalis* were caught altogether here and also one fed female of *A. nili*. It is worthy of remark that this was the solitary occasion on which *A. nili* was captured in a house. That this mosquito is prepared to feed on huuman beings was proved by the fact that on one occasion three out of a number of bred specimens fed well, inflicting a bite which was not by any means painless; that is to say that the bite would have attracted attention. It is not without interest, that whereas this native house daily contained numerous fed anophelines, the officers' house immediately adjacent to it, and the other officers' quarters remained comparatively free of anophelines; this appears to be the case even when due allowance is made for the size and height of the houses.

To sum up, the evidence from this survey of houses supported the belief that the anophelines which had made their way into the officers' houses had come from Swamp A. Further, the evidence pointed to the fact that in their progress from the swamp in search of blood the female anophelines stopped at the first house they encountered and stayed there as a rule; there was, however, some tendency to overflow into the barracks quarters. The fact that the few native houses intervening between the swamps and the cantonment acted thus as a more or less efficient screen for the camp is important. Any feeling of security derived from this consideration must, however, be balanced against certain dangers which such a screen may give rise to, namely, the dangers of the overflow mosquitoes carrying infection with them from the infected natives.

(*C*) *Identification of Mosquitoes.*—With the exception of numerous adult female *A. costalis* and one female *A. nili* captured, all the specimens identified were reared from pupæ or larvæ.

The identifications were made for me by Miss A. M. Evans, Liverpool School of Tropical Medicine, The Daru collection consisted of twenty-two species and included one new species and one new variety and several species which have not hitherto been recorded from Sierra Leone, i.e., *Anopheles costalis* (Loew), *A. mauritianus* (Grand), *A. umbrosus* (Theo.), *A. nili* (Theo.), *Culex* (*Culiciomyia*) *nebulosus* (Theo.), *Aëdes* (*Stegomyia*) *africanus* (Theo.), *Aëd.* (*Finlaya*) *longipalpis* (Grunb.), *Eretmopodites chrysogaster* (Graham), *Toxorhynchites brevipalpis* (Theo.), *Aëd.* (*Stegomyia*) *blacklocki* (n. sp.), *Aëd.* (*Aëdimorphus*) *tarsalis* (Newst.), *Aëd.* (*Stegomyia*) *simpsoni* (Theo.), *C. Decens* var. *invidiosus* (Theo.), *Lutzia tigripes* var. *fusca* (Theo.), *Aëd.* (*Aëdimorphus*) *domesticus* (Theo.), *Aëd.* (*Stegomyia*) *apicoargenteus* (Theo.), *C. annulioris* (Theo.), *Uranotænia nigripes* (Theo.), *Uranotænia fusca* (Theo.), *Aëd.* (*Stegomyia*) *argenteus* (Poiret), *Aëd.* (*Aëdimorphus*) *comminsi* var. *daruensis* (n. var.), *Mimomyia hispida* (Theo.).

Reviewing these mosquitoes, the commonest anopheline found was *A. costalis*, which was breeding in both Swamps A and B right down to their entrance to the river, in the hospital drain and in the stream between headquarters line and A company lines. *A. nili* was confined to the margin of the river. These two anophelines were the only ones captured in houses, and in the case of *A. nili* only one specimen was so obtained. *A. mauritianus* was found in Swamp B, while *A. umbrosus* was found in the upper portion of Swamp A.

It is worthy of note that among the large number of mosquitoes called *Aëd.* (*Stegomyia*) *argenteus*, the proved carrier of yellow fever was found only in one breeding place, that is, in the latrine bucket containing water. This rarity is probably due chiefly to the adequate measures adopted in the cantonment for the prevention of tins, bottles and other artificial receptacles acting as breeding places. But even so the absence of *Aëd. argenteus* from tree and plant breeding places is remarkable; such breeding places harbour this species not infrequently in the neighbourhood of Freetown. It was observed that the larvæ of megarhinines were usually found alone in small collections of water in trees and plants and their predaceous habits were also observed in breeding-out experiments. It is possible that part of the scarcity of *Aëd. argenteus* at Daru may be connected with the presence of such predaceous larvæ.

IV.—Measures for Reducing Mosquito Breeding.

The steps taken to deal with the breeding places of mosquitoes must be considered largely from the point of view of cost. It would doubtless be possible, if expense were no object, to deal in a radical manner with the breeding places by large schemes of swamp drainage and filling. But such schemes, however desirable, are quite out of the question at Daru at present. Instead, therefore, of suggesting large and comprehensive schemes, the following measures will in a reasonable time and at moderate expenditure greatly diminish the risk of acquiring mosquito-borne diseases in the cantonment.

The first recommendation is that advantage should be taken of the assistance of the native troops in rendering the barracks and its environments more healthy. One native soldier should be detailed each week to act as a mosquito hunter. His whole duty during the week should be to discover breeding

places and, having marked them down, to report them. On his reporting a breeding place, action with regard to it should at once be taken. At the end of each week the man who is to be on duty for the succeeding week should spend two days with him in order to learn his duties.

The results of this procedure will be twofold; firstly, all breeding places will almost infallibly be discovered and dealt with, which is in itself a matter of no small importance; secondly, the knowledge of how to look for, discover and deal with mosquito breeding places will extend steadily among the troops. Each individual will become imbued with ideas which will render him an extremely useful ally in the campaign against insect-borne diseases. The more clearly native troops in tropical countries grasp the essential elements of hygiene, the more efficient they will become as a fighting force, and nowhere is the truth of this statement more evident than in warfare in the African bush.

This educational policy should be the basis of all further action here! It is not a policy which could be carried out successfully in any casual community, but the community of Daru is not a casual one but a highly specialized one. In the circumstances there, there is no hesitation in recommending it as a practical policy which, conscientiously carried out, will produce good results. Its application will now be considered in conjunction with the other recommendations.

(*a*) Minor Operations.—(*i*) Starting from the creek above the railway bridge the edge of the river should be denuded of grass and weed; this process should be carried out along the whole of the front of the barracks where it has not already been done. The side streams leading to the river from the high ground within this limit should be drained and cleared of grass and weed. All trees which have fallen into the river should be dealt with if they are in a position to afford lodgment of water. In case of a rise in the river level, any pools which form on the banks will be examined and reported on by the man on duty. In the dry season there is the additional problem of rock pools on the reef in the river bed. Owing to the high level of the river during my visit it is not possible for me to give in detail measures necessary to eliminate these; a statement is given based on experience of what appears to be similar conditions elsewhere. Wherever the rock pool has a sufficiently thin wall it should be drained permanently by breaking through the wall with a jumper-chisel and sledge hammer. Where the wall of the pool is too solid for such a treatment the pool should be emptied quite dry by syphonage or baling. Failing this resort may be had to filling in with concrete or to the use of oil or chemical treatment of the breeding places.

(*ii*) *Swamp A.*—The first step to be undertaken in the treatment of this swamp is the cutting of the bush along its margin from where the creek enters the river to the point where the stream passes under the railway near the clerk's house. Along this stretch the establishment of farms and gardens would keep the bush cleared from the railway line up to the edge of the swamp. A path or, if necessary, a series of paths should be kept parallel to the edge of the swamp so that it may be readily accessible to the soldier whose duty it is to inspect it for breeding places; these paths should be opened and kept open by each farmer on his particular ground. The edge of the swamp should be kept clean of grass and weeds; each farmer being responsible for that portion opposite his own farm.

(*iii*) *Swamp B.*—Most parts of this swamp are more remote from the barracks than is Swamp A. At one point opposite the parade ground there is a stream in which anophelines breed; it is recommended that a good path be made from the parade ground down to and along this stream and that it should be continued to where the stream enters the swamp. The stream should be cleared of bush, grass and weed, and can then be properly and regularly examined by the soldier on duty. Along that portion of the swamp itself which lies opposite to the present and proposed new lines, the bush should be cleared and farms established on a similar basis to those along the edge of Swamp A.

(*iv*) *Trees, Stumps and Shrubs.*—On the report of the discovery of a potential or actual breeding place in these sites, appropriate action should at once be taken to deal with them. The action will depend on the value of the tree or shrub. In case of stumps and trees of no economic, æsthetic or shade value, removal by felling and digging and blasting is the proper method, the ground being filled in and smoothed afterwards. Where for any reason it is desired to retain the tree or shrub, an outlet for all the water it contains should be cut and the cut surface tarred. Filling in holes with earth or concrete is not recommended except as a last resort in the case of trees of special value which cannot be treated effectively by cutting a channel for the water, since spaces develop later, as the rot hole becomes larger, and breeding goes on between the filling and the tree hole walls.

(*b*) Major Operations.—(*i*) *The Hospital Drain Area.*—As a temporary measure the wet triangular area inside the railway may be trenched so as to collect the water within definite limits. The water in the trenches and in the drain can then be treated with oil, but the permanent obliteration of this marshy area is necessary at the earliest possible time. This can be accomplished by filling in a triangle with its base on the railway and its apex extending to the foot of the slope down which the first portion of the hospital drain runs. As we saw, the present level of the drain to the railway is too low and the water becomes dammed back in it. The drain will therefore require to be relaid at such a level and with such a slope as will allow the water carried by it to pass under the railway and have a fall into the swamp beyond the embankment. In carrying out this operation all material for filling it should be collected and the filling carried out from without inwards, leaving the drain itself to be dealt with as the last of the operation.

Colonial Medical Reports.—No. 195.—Sierra Leone *(continued).*

The proper level to which the ground must be raised will have to be determined by a skilled engineer. In the filling in of this area the railway department could render valuable assistance by surveying the ground and by supplying material for filling. The work could best be carried out in the dry season, but the contingency of exceptional high water in the swamp, as, for example, this year, should be provided for fully in deciding the height of filling required. The only essential points are that the marshy area should be eliminated, that the drain should have a good slope, and that it should have a definite fall into the swamp, even when the water in the swamp stands at an exceptionally high level.

(*ii*) *Permanent Improvement of Swamp A.*—The above operation having been completed, it is advisable to adopt a definite policy with regard to Swamp A. The policy which appears to hold out the best prospects of success is to make a steady and progressive encroachment on the swamp from the railway outwards. By the time this stage is reached the progress of clearing should have so far advanced as to make it possible to define the best limiting line along which filling can be done, so as to leave a straight edge to the reclaimed land beyond which the water of the swamp can be constantly kept. It is here, above all, that the greatest assistance can be given by the railway department. In fact, it does not appear probable that much can be done in this direction without the active co-operation of that department; with this co-operation much could be done. The method of co-operation suggested is that the engineer should determine the best line to leave for the swamp water, and that a siding should be made in which trucks of earth, ashes, stones and other waste material provided by the railway department could stand while their contents are being discharged. The labour required for unloading, transporting the material, and filling in should be provided by the military authorities.

In the case of Daru, if the scheme of filling in Swamp A is adopted, a very useful way of disposal of the majority of the camp refuse would be to utilize it for filling in this swamp. There is an incinerator of small size which can be used for kitchen refuse. The remainder of the camp refuse should be taken to the margin of Swamp A and treated there. The treatment will consist of separating all combustible material and burning it. The incombustible material can be disposed of as follows: The material supplied by the railway having been filled in along a section of the edge of the swamp sufficiently high to raise it above water level, the refuse is laid on in a layer of about two feet thick. This is then covered with a layer of a foot or so of soil and pressed down firmly. In this way a waste product is turned to good account in the sanitation of the cantonment. A small amount of kerosene sprinkled on the refuse before burial would help to prevent fly breeding and by oozing gradually into the swamp act as a useful anti-mosquito agent. The subsidence in the trenched area which will gradually occur can be rectified later by the deposit on the surface of soil from the filling in material supplied by the railway.

Colonial Medical Reports.—No. 196.—Nyasaland Protectorate.

NUAL MEDICAL AND SANITARY REPORT FOR THE YEAR ENDING DECEMBER 31, 1925.

General Diseases.

Beriberi.—Three cases were reported this year, two from Fort Johnston and one from the Central Prison. There were not any reported during the previous year.

Pellagra.—Sixty-three cases were treated with one death, as compared with 137 in the previous year. Of the 63 cases, 43 were reported from the Central Prison and 12 from the lunatic asylum. The cases are being treated with 2 gr. of thyroid extract daily with good results.

Communicable Diseases.

(A) *Insect-borne Diseases.*

Malaria.—During 1925, 3,303 cases were reported with 5 deaths. Of these cases, 2,071 were reported from the rural dispensaries by native dispensers, who have no microscopes. Last year 3,461 cases were reported with one death.

Of the cases in 1925, Europeans numbered 113 (two deaths), as against 76 (one death) in 1924 and 126 (no death) in 1923. Quinine powder in packets of three 5-gr. doses is sold at all post offices for 1d. a packet; 1,025 packets were sold during 1925. Bottles of 100 5-gr. tablets of quinine bihydrochloride are also on sale to the public at all post offices and 1,561 bottles were sold during the year.

Blackwater Fever.—Four cases of blackwater fever were notified with 3 deaths. One of these cases was in an Asiatic and the other 3 in Europeans. The returns for the previous four years were 5, 14, 14 and 11.

Tick Fever.—During the year 128 cases were reported, of which 4 were Europeans: 82 were reported in 1924, 71 in 1923 and 47 in 1922. Most of the cases occur in stations in the northern and central provinces. Fort Johnston and Zomba reported 29 and 32, respectively. Most of the Zomba cases, however, are infected up country; very often

people visit a district where the disease is prevalent, and on their return to Zomba they come to the hospital for treatment.

Trypanosomiasis.—Two cases of sleeping sickness were reported in Africans; both of them died. Both cases were admitted to hospital in the final stage and succumbed shortly after admission.

(B) *Infectious Diseases.*

Small-pox.—One case of small-pox was reported from Mzimba. It is not known how the man became infected.

Chicken-pox.—During 1925, 17 cases (1 European) were reported, as against 70 in 1924

Cerebrospinal Fever.—Five cases were reported, of which 2 died.

Enteric Fever.—Six cases of the enteric group of diseases were treated, of which 1 was a European with typhoid, 2 were natives with paratyphoid, and 3 were undefined cases in natives reported by native dispensers. In 1924 there were 11 cases.

Influenza.—A mild type of influenza occurred which spread over practically the whole country. There were not any deaths reported amongst the 495 cases, of which 15 were Europeans. In 1924 there were 753 cases (17 Europeans) with 1 death.

Leprosy.—During the year 29 cases were treated as compared with 28 during 1924. In addition 14 cases were seen at the rural dispensaries. Moogrol is used for treatment. With a few exceptions, however, the treatment of the cases is not very satisfactory, as the patients do not feel inclined to persevere with the treatment for the requisite length of time. It so often happens that a patient lives many miles from a hospital and will not come in weekly for the injection, nor can he stay in the hospital for the length of time necessary. In some districts much good work could be done if a medical officer could be appointed to devote all his time to leprosy in the district, so that in addition to managing a special hospital he could travel over the district and hold weekly clinics at suitable centres. A single medical officer in a district can only treat cases that come to the hospital; he is not in a position to hold regular clinics in several places. Except in a very few cases the native dispensers are not sufficiently trained to treat cases of leprosy.

A census of lepers was taken in one district, and a plan was proposed for starting a special leper hospital; but funds are not sufficient to carry it out.

Plague.—There were not any cases reported during the year.

Tuberculosis.—Seventy-two cases with 10 deaths occurred, as compared with 45 (9 deaths) in 1924. Of these cases, 27 were reported from Zomba.

Venereal Diseases.—As compared with 183 last year and 72 in 1923, 263 cases of gonorrhœa were treated; of these, 157 were treated at the rural dispensaries.

There were 528 cases of syphilis, as against 576 in 1924; 201 were treated at the rural dispensaries and would not receive such thorough treatment as those at the hospitals, who are treated with novarsenobillon or with injections of bismuth.

Yaws.—The number of cases treated this year was only 760, as compared with 1,776 in 1924. The falling off of cases has occurred in the rural dispensaries, which only treated 307 cases, as against 1,137 in 1924. There were, however, some 900 treated by a mission on the lake shore, under the direction of the medical officer, which are not recorded in the returns.

At the hospitals the large majority of cases were treated with injections of sodium bismuth tartrate with excellent results. In some cases medical officers found that the injection caused a considerable amount of pain, and now a more concentrated solution of the drug is being tried in the hope that it may be less painful.

Helminthic Diseases.—The main helminthic infections in this country are ankylostomes and schistosomes. Infections by ascaris and tænia are also common.

Ankylostomiasis.—Microscopic examinations of the fæces of groups of natives have been made at various times and in various places in order to ascertain approximately to what extent hookworm exists. In some groups at Zomba it was found that over 90 per cent. were infected, whilst at Mlanje a group examined recently revealed an infection of only 28 per cent.

In the ordinary way the infection appears to have little effect on the health of the individual. Under certain conditions, perhaps an unusually heavy infection of ankylostomes, or perhaps semi-starvation, the usual symptoms of ankylostomiasis appear, and then the patient may present himself for treatment. It is thought that the inability to carry out sustained labour is due partly to ankylostome infection and partly to deficient or unsuitable diet.

During 1925, 481 such patients were treated. For treatment carbon tetrachloride is generally used, and this is issued free to employers of labour and all medical men.

The proportion of *americanum* to *duodenale* has not yet been ascertained, but from occasional investigations made it would appear that *americanum* is uncommon and that the infections are mostly *A. duodenale*.

Schistosomiasis.—Two hundred and ninety cases of *S. hæmatobium* and 77 of *S. mansoni* were reported during the year. In addition to these the rural dispensaries reported 38 cases of hæmaturia, of which there is little doubt that a number were due to *S. hæmatobium*. These cases are very common on the lake shore.

Vital Statistics.

General Native Population.

Vital Statistics of the general native population are not available. The population is estimated to be 1,205,801.

General European Population.

During the year 548 cases were treated amongst the general European population by Government medical officers. The numbers treated by medical

officers attached to the missions are not known. There were 6 deaths amongst the 548 cases.

The total number of European deaths recorded by the Registrar-General was 19. The number of births was 48, as compared with 42 in 1924.

European Officials.

During the year there were 95 cases treated amongst officials; of these cases 69 necessitated the officials being off duty. One official died, whilst on leave, from complications following an appendix abscess.

The chief disabilities were: malaria, 25 cases; infections of the upper air passages, 15 cases; minor injuries, 10 cases; diarrhœa, 3 cases.

HYGIENE AND SANITATION.

The absence of the sanitation officer on leave in England makes the compilation of a report upon hygiene and sanitation in the Protectorate a matter of difficulty, and reliance for data has had perforce to rest mainly upon the annual reports sent in by the various medical officers scattered throughout the country. Since only a limited area of the Protectorate is covered by the activities of medical officers and sub-assistant surgeons by reason of the small number of staff, this report must be regarded as somewhat inadequate, although, in the main, it can be taken as reflecting the general state of sanitation in the Protectorate.

(A) GENERAL REVIEW OF THE WORK DONE AND PROGRESS MADE.

(1) *Preventive Measures.*

Mosquito and Insect-borne Diseases.—Preventive measures for the eradication of malaria have been as heretofore of a very limited and temporary character. The sanitary gangs at work in the various townships and on Government stations have done as much as has been possible to keep clear such places as breed and harbour mosquitoes. Sanitary work of a temporary and makeshift character is always unsatisfactory, and since it entails a constantly recurring expenditure of funds is, in the long run, more expensive than works of a permanent nature, and it is unfortunate that the financial state of the country prohibits the carrying out of such works as would make the elimination of malaria a possibility in the more populous parts of the Protectorate. In spite of many difficulties the gangs have been able to effect some slight improvement on the whole. The notable exception to this is seen on such stations as are near the lake or rivers. To attempt anything of even a temporary nature would mean a very considerable increase in the amount allocated to sanitary works.

Trypanosomiasis.—For scientific work done on this problem see the report submitted by Dr. W. A. Lamborn, medical entomologist. No case of sleeping sickness has been reported. The results of the proposed scheme to create barriers to the advance of the tsetse fly into hitherto uninfested areas will be awaited with great interest. The present threatened invasion of highly populous districts can only be viewed with grave uneasiness in view of a possible sudden outbreak of human trypanosomiasis. Beyond a very limited survey made in 1922, at the time of a reported outbreak of the disease when some villages were moved, lack of funds has prevented the continuance of the work done in 1913 with regard to the extent of the disease amongst the natives in Nyasaland.

Epidemics.—During the year the country has been singularly free from outbreaks of infectious diseases. There was an outbreak of measles in the Lilongwe district during the heavy rains; the mortality rate 11·4 per cent. (2,067 cases) was high but not higher than was to be expected in a zymotic disease breaking out during the rainy season, when the housing and mode of living of the natives are taken into consideration.

Efforts to prevent the spread of infectious diseases have consisted merely in the isolation at native hospitals of such cases as have sought relief. Since only a very limited number of natives avail themselves of medical assistance when seriously ill the liability to the outbreak of serious epidemics is constantly present. As regards prevention of the spread of small-pox, the task of vaccinating the natives has been carried out as in former years. The returns are as follows: Number vaccinated, 80,699; successful, 26,973; modified, 22,517; failed, 28,370; not seen, 2,839.

As at present carried out this work can only be regarded as most unsatisfactory. Any medical officer who takes the trouble to go through his district and check the returns submitted by native vaccinators will not go far before he realizes that without supervision the work will not be properly carried out. So much so is this the case that the figures given each year rather tend to give one reading them a sense of false security as regards the protection afforded the natives against small-pox. The amount of money devoted to vaccination is inadequate considering the size of the native population.

Helminthic Diseases.—Efforts to prevent the spread of these diseases can be regarded as fairly successful in the military and police camps. Amongst the general native population, where pit or other latrines have been provided, any benefit that may be expected to accrue from the provision of such facilities is largely nullified by the fact that the women decline to use them and retire to the nearest patch of scrub. This, to a certain extent, holds good with both sexes during the hours of darkness. Even in the townships and on the stations and plantations where proper sanitary provision is made for the natives, the conditions are very bad, whilst in the villages the prevalence of flies in myriads tells its own tale.

(2) *General Measures of Sanitation.*

Night soil and refuse are disposed of by burial, except in Port Herald, where an incinerator is in use. They are buried in pits or trenches, generally in the compounds, but outside if ground is available. In Blantyre they are carted outside the

township and buried. In spite of frequent inspections by the sanitary staff these pits are generally in a foul state. Occasionally one finds a householder in whom the sanitary conscience is developed, but such are the exception rather than the rule, in spite of frequent warnings regarding the risks they run from having insanitary compounds. The very rocky nature of the ground in most parts of Zomba makes the digging of suitable pits well-nigh impossible, and this fact, coupled with the carelessness of householders and their domestics, makes the state of many of the compounds truly deplorable.

Storm-water drainage is effected by means of earth drains. In the township these are being gradually replaced by brick ones.

For the supply of water, for drinking and domestic purposes, reliance is made on springs, streams and wells where lake or river water is not available. Where stream and river is used such is very liable to pollution by natives, since the banks of streams and rivers are naturally favourable sites for their villages. The onset of the rain marks the commencement of outbreaks of enteritis, and there is no reason to assume that these are due entirely to the concomitant increase in the number of flies present in the villages. Well water is often of doubtful purity and seldom are the wells rendered mosquito-proof. In Blantyre rain-water tanks are in use.

In and around all the townships and stations the clearance of grass and undergrowth is carried out as regularly as the supply of labour permits. During the rainy season the want of sufficient funds to permit the employment of enough labour for this work renders it imperfect.

Sanitary inspections are carried out regularly where medical officers and sub-assistant surgeons are stationed. In the townships native sanitary inspectors are employed. Their usefulness is limited to reporting to the medical officer such conditions as appeal to them as being insanitary.

(3) *School Hygiene.*

Except for two small schools for European children all the schools are run by missionary societies. They are kept in a satisfactory state. These schools naturally afford excellent opportunity for instilling into the minds of the young natives ideas regarding personal hygiene as well as sanitation. How far this opportunity is taken advantage of is not known.

(4) *Labour Conditions.*

Industrial conditions in general cannot be said to be very satisfactory from either a medical or economic point of view. Only a comparatively small proportion of the native population have become industrialized in the sense that they are regularly employed throughout the year, and, until we see some serious effort made to improve their conditions whilst employed, mainly as regards health, housing and feeding, there is no reason to expect that proportion to be greatly increased. Should we see an increased desire on the part of the natives to embark upon the production of economic crops suitable for export, it is likely that we shall see a marked decrease in the numbers seeking either skilled or unskilled labour.

Skilled labour is recruited from Government or private workshops and the mission stations. The conditions of those engaged in clerical work are satisfactory. Such, however, cannot be said of those employed at trades requiring any degree of hard manual labour.

One constantly hears complaints regarding the indolence of labourers and their incapacity for any sustained muscular effort. One wonders how much of this is due to the natural laziness of the native and how much to the fact that his dietary is of such a nature as to preclude the possibility of greater muscular output. The dietary of the manual worker differs very little from that of the native sitting in idleness in his village, and that is not suitable for a man engaged in hard work.

Casual labour engaged in Government works is recruited mainly from volunteers with a small percentage of hut-tax defaulters to make up the balance. Labour for factories and plantations is recruited from whatever part of the Protectorate the men can be induced to take up work. The average casual labourer only works for from three to six months of the year, according to his financial needs. During the rest of the year he is building or repairing his huts, preparing new ground for his crops or sitting in idleness at home.

Domestic servants and natives in Government and factory employment are fairly well housed. Such is not the case with regard to the general run of workers, and particularly with regard to the natives employed on plantations. These are generally housed in ramshackle grass and pole huts which are often burned or fall down, and, from the nature of their construction, are insanitary. The general conception seems to be that, since the native lives in such a dwelling in his village it is good enough for him on a plantation or anywhere else, regardless of the fact that the oft-repeated construction of a building, however cheap it may be in the first instance, does not make for economy in the long run, and that such a structure is from an hygienic point of view not suitable for human habitation.

Looking after the welfare of native labourers of the casual variety is on all fours with the housing allotted to them. There is no standard rule regarding the feeding of their employees amongst Europeans. Domestic servants and some in Government employment are given a small weekly allowance in addition to their pay for the purchase of such "delicacies" as they may fancy to augment their food. Casual labour is generally given rations of maize, meal, rice and beans. Few, if any, are given meat and fish as regular rations. Their food is cooked by themselves, no special arrangement for carrying this out being provided by the employers. The ideas regarding the feeding of their labourers is the same as that of their housing, so it is not surprising that employers complain of the small amount of work they get out of them.

Colonial Medical Reports.—No. 196.—Nyasaland Protectorate *(continued).*

Natives, in the main, are content with a hand-to-mouth existence, and when we take into consideration their natural indolence, coupled with debilitating diseases such as ankylostomiasis and ill-balanced dietary, it is not surprising that wages are small and industrial progress is slow. The first step towards an improvement in the existing state of affairs must be taken by the employers of labour. With improved housing and general conditions, better feeding and adequate medical care when sick, the output of work would be greater, the native would earn more money, and work of a continuous nature would hold some attraction for him.

The medical care of labour engaged in public and private works and in factories and workshops is, on the whole, satisfactory. There exists the usual difficulty of dealing with the native when he is sick, in that many are loth to take advantage of such facilities as are at their disposal for treatment. During the last few years his opportunities for receiving proper treatment have been much improved by reason of the greater number of native hospitals and dispensaries that have been erected and equipped. The treatment of natives on plantations varies according to the employer's attitude towards his natives generally. One can say that, on the whole, the treatment of natives on plantations during sickness is very far from satisfactory. If the plantation is situated near a hospital or dispensary there is some chance that the employer will do something towards assisting his sick employee. If situated far from skilled medical assistance the treatment of the sick will be of a most perfunctory nature, for few will even go so far as to employ a half-trained native dresser. Apart from the economic necessity for keeping all employees in a good state of health it should be made compulsory that all employers of labour make adequate provision for the medical treatment of their labourers.

(5) *Housing and Town Planning.*

The housing of Europeans in the highlands is, on the whole, satisfactory and as good as finance will allow. The same cannot be said for it in the highly malarious localities. In the latter even partially mosquito-proofed dwellings are not the rule, and where attempts have been made to mosquito-proof part of the house the result has generally been the creation of a mosquito-trap. The erection of proper houses, double-storied and wholly mosquito-proof, might be expensive, but it would be warranted by reason of the maintenance of the health and efficiency of those whose duties compel them to live in low-lying areas.

Zomba, because of geographical considerations, does not lend itself to suitable town-planning schemes, and houses are built on more or less suitable sites as they are required. The other townships show some efforts were made originally to lay them out on proper lines.

(6) *Food in Relation to Health and Disease.*

At Zomba and Blantyre meat inspection is carried out by the veterinary officers and, in their absence, by the medical officers of health. Apart from this any question that arises on the score of bad or doubtful food is a matter between the consumer and the purveyor, when, very occasionally, the medical officer of health is called upon to give his opinion. There are no public health laws in existence, and until such are adopted and a staff appointed to enforce them it is useless to discuss the subject of food so far as the control of its sale is concerned.

(B) Measures taken to Spread the Knowledge of Hygiene and Sanitation.

There are no measures taken to spread systematically the knowledge of hygiene and sanitation. Any efforts that are made are tentative ones on the part of the medical staff in the course of ordinary duties. As suggested, this matter could very well be dealt with in the schools.

(C) Training of Sanitary Personnel.

The system of training sanitary personnel inaugurated by the sanitation officer has been in abeyance during his absence on leave.

(D) Recommendation for Future Works.

(1) The employment of European sanitary inspectors at Zomba, Blantyre and Limbe.

(2) That adequate rating of the inhabitants be made to furnish means for the proper disposal, outside the townships, of all night soil and refuse.

(3) The strict segregation without the townships of all natives and Asiatics whose employment does not necessitate their being in the township over night. The former should be housed in properly laid out locations. With suitable sanitary arrangements provided in such locations these would prove valuable educative factors in instilling ideas of sanitation into the minds of those dwelling in them. The natives would enjoy greater freedom than they have now whilst living in close proximity to Europeans. This is the only means of rendering any sanitary measures to be carried out for the benefit of European populations effective. At present the so-called European townships are only European in name: for the fact that the ratio of Europeans to coloured is, estimated conservatively, one to six renders the title European absurd. The constant menace to the health of the Europeans from the presence of so many coloured people is obvious.

(4) The provision of pure pipe-borne water supplies to Zomba and Blantyre and, where possible, to other townships. Until such is made possible the adequate policing of all sources of water supply in the township is necessary.

(5) The employment of European or Asiatic inspectors of vaccination.

(6) The creation of a labour department to work in conjunction with the Department of

Native Affairs and the Medical Department to control and supervise by means of its labour inspectors the recruitment and treatment of all native labour.

Hospitals and Dispensaries.

Zomba.

European Hospital.—The number of admissions during the year was 64 and the daily average in hospital 2·2. There were 4 deaths. The out-patients treated numbered 82. In 1924 the in-patients were 56 and the out-patients 143. During the year one ward, which contained 6 beds, has been divided into two rooms, suitable for confinement cases.

Native Hospital.—The number of admissions during the year was 955 and the out-patients were 2,450. There were 22 deaths. In 1924 there were 464 in-patients and 4,118 out-patients, with 10 deaths. In 1924 the hospital was only open for 9 months, as it was started in April, which partly accounts for the much larger number of admissions in 1925; but apart from this, the new hospital is much more popular than the old one was. The decrease in the number of out-patients this year is accounted for by the opening of two dispensaries near by; these take a considerable number of minor cases which otherwise would attend the hospital.

Dispensaries.—Apart from the dispensaries which are ordinarily attached to the hospitals, there are 3 in the Zomba district. These 3 between them treated 5,762 cases. The Central Prison Hospital, the asylum and the military hospital are considered under their respective sections.

Blantyre.

European Hospital.—The number of admissions during the year was 128, with 6 deaths, as compared with 91 and 3 deaths in 1924. The out-patients were 177, as compared with 71 in 1924.

The Native Hospital at Blantyre was closed in 1925. This hospital was not large enough, was in disrepair and ill-equipped, so instead of building a new one it was considered more economical to send all natives requiring indoor treatment to the Blantyre Mission Hospital and to pay the mission a retaining fee for this work. The dispensary for out-patients is still carried on. This scheme has been in operation since April 1, 1925, and from then until the end of the year 54 patients were sent from the native dispensary to the mission hospital as in-patients. The out-patients treated were 2,203, as compared with 2,802 in 1924. There is one rural dispensary in the Blantyre district at Lirangwe, where 840 patients were treated, as against 720 in 1924.

Fort Johnston.

Native hospital: In-patients 132 with 9 deaths; in 1924 there were 211 with 6 deaths. Out-patients 1,021; in 1924 there were 720. There are four rural dispensaries in the district, which treated 2,092 cases, as compared with 2,215 during the previous year.

Mlanje.

Native hospital: In-patients 171 with 16 deaths; out-patients 657. In 1924 the numbers were 136 (6 deaths) and 334 respectively. This hospital is not nearly large enough and requires an extra ward. There are four rural dispensaries in the district, which treated 1,196 cases, as compared with 1,567 cases in 1924.

Dedza.

Native hospital: In-patients 87 (3 deaths) as compared with 55 (3 deaths) in 1924. Out-patients 1,092, as compared with 1,220 in 1924. There are four rural dispensaries in the district, which treated 5,846 new cases, as compared with 2,891 in 1924. The medical officer has given special attention to the treatment of yaws on the lake shore. Considerable success has attended the use of bismuth sodium tartrate.

Karonga.

Native hospital: In-patients 427 with 4 deaths; out-patients 5,034. In 1924 the numbers were 338 (2 deaths) and 4,955 respectively. There are four rural dispensaries which treated 5,562, as against 9,288 cases in 1924. One of the dispensaries was closed for a considerable time and this accounts to a certain extent for the falling off in numbers.

Kota-Kota.

A new hospital was opened here at the beginning of the year, and a medical officer has been stationed here since the middle of 1924. During the year 126 in-patients were admitted with 4 deaths. The out-patients numbered 4,261, as compared with 3,200 in 1924. There are four rural dispensaries, the fourth being opened towards the close of the year; 9,760 cases were treated at the rural dispensaries.

Port Herald.

Native hospital: In-patients 133 (6 deaths); out-patients 962. In 1924 there were 159 in-patients (7 deaths) and 855 out-patients. There are five rural dispensaries and 3,291 patients were treated at them, compared with 2,140 last year.

Lilongwe.

Native hospital: In-patients 171 (10 deaths); out-patients 1,947. In 1924 the numbers were 135 (7 deaths) and 1,437. There are four rural dispensaries, at which 1,442 cases were treated in 1925 and 918 in 1924.

Mzimba.

Native hospital: In-patients 127 with 8 deaths; in 1924 there were 119 with 4 deaths. Out-patients 2,322; in 1924 there were 2,174. There are five rural dispensaries, which treated 4,308 new cases, as compared with 4,741 in 1924.

Chikwawa.

Native hospital: In-patients 73 with 3 deaths, out-patients 1,532. In 1924 there were 26 in-patients with 1 death and 1,587 out-patients. The seven rural dispensaries collectively treated 4,460 cases as compared with 2,062 in 1924.

Fort Manning.

Native hospital: In-patients 103 (no deaths); out-patients 1,364. In 1924 the numbers were 53 (5 deaths) and 2,200 out-patients. There are three rural dispensaries and they treated 2,253 cases in 1925 and 1,917 in 1924.

Dowa.

Native hospital: 77 cases (2 deaths) and 2,320 out-patients. In 1924 there were 20 in-patients admitted (1 death) and 3,805 out-patients. There are four rural dispensaries, at which were treated 2,846 cases during 1925 and 1,611 in 1924.

Ncheu.

A sub-assistant surgeon has been posted at Ncheu since October, 1925. There is not a hospital, but 5 patients were treated as in-patients, being kept in two small native huts. The dispensary treated 1,085 cases. There are three rural dispensaries in the district, which treated 2,780 cases.

Of the 14 above-mentioned districts, the first 7 each have a medical officer, the remaining 7 each have a sub-assistant surgeon. Dowa and Ncheu had a sub-assistant surgeon for the last two or three months in the year only.

In addition to these districts there are 6 others which have not a medical officer or sub-assistant surgeon. They have rural dispensaries which are worked by native dispensers.

Prisons and Asylums.

Central Prison, Zomba.

The general health of the prisoners during the year has been good; many prisoners when first admitted are in a poor state of health owing to hookworm, bilharzia or poor feeding, but they improve considerably after a period of prison life. During the year there were 7 deaths, due to the following causes: lobar pneumonia, 3 cases; ankylostomiasis (and pellagra), 1; beriberi, 1; cardiac failure, 1; sarcoma of the ilium, 1.

The following is a return of the diseases treated during the year at the Central Prison:

Infective Diseases.—Dysentery (amœbic), 2; bacillary, 2; gonorrhœa, 6; leprosy (anæsthetic), 6; malaria (subtertian), 63; pneumonia, 33; syphilis, 6; tuberculosis, 3.

General Diseases.—Beriberi, 1; pellagra, 43; asthenia and debility, 10.

Nervous System.—Neuritis, 4; headache, 15.

Diseases of the Eye.—Conjunctivitis, 9.

Diseases of the Ear.—8.

Diseases of the Circulatory System.—Valvular disease of the heart, 3.

Respiratory System.—Bronchitis, 91; pleurisy, 5; asthma, 2; other diseases, 8.

Digestive System.—Caries of teeth, 11; sore throat, 16; tonsillitis, 10; dyspepsia, 3; enteritis, 9; hernia, 1; diarrhœa, 13; constipation, 43; colic, 5; other digestive diseases, 4.

Diseases of the Lymphatic System.—Adenitis, 3; lymphadenitis, 1.

Diseases of the Generative System.—Hydrocele, 2.

Organs of Locomotion.—Periostitis, 3; synovitis, 1; tenosynovitis, 6; fibrositis, 49.

Diseases of the Connective Tissue.—Cellulitis, 14; abscess, 10.

Diseases of the Skin.—Eczema, 8; boil, 29; herpes, 1; tinea, 42; scabies, 30; ulcer, 13; dermatitis, 2.

Injuries.—333.

Tumours.—Sarcoma, 1.

Parasites.—Schistosoma, 16; tænia, 4; ascaris, 1; ankylostoma, 28. Total, 1,032 cases.

Lunatic Asylum.

The daily average number of inmates during 1925 was 47·9, as compared with 40·7 in 1924 and 35·3 1923. Each year shows an increase in the number of admissions, and enlargement of the asylum is now required.

During the year 33 patients were admitted to the asylum hospital, as compared with 25 during the previous year. Attending the dispensary as out-patients there were 62, as against 78 in the previous year. The 5 deaths were due to: pneumonia, 2; pellagra and syphilis, 1; bilharzia, 1; and ankylostomiasis, 1.

Restraint was imposed upon 10 inmates; of these, 6 were restrained by seclusion (longest period 21 days) and 4 by handcuffs or leg-irons.

There were not any serious injuries. One violent inmate was slightly injured by a warder, who had to defend himself when attacked. There were 2 cases of slight injury to warders by patients.

Appendix I.

Medical Entomologist's Annual Report for 1925.

Concerning the tsetse-fly problem, steps were taken during the earlier part of the year to ascertain the final outcome of the field experiment undertaken towards the end of last tour for the purpose of ascertaining the degree to which it might be possible to effect the control of *Glossina morsitans* through the agency of a parasite, *Syntomosphyrum glossinæ*, attacking the puparia. A large number of these parasites, estimated at 277,179, were then distributed, the outcome being that by the end of March, 1924, the percentage of puparia found to have been attacked had risen from 0·05 to 12. In the course of the more recent work, up to March, 784 sound puparia were collected, 16 of which afforded the insects a parasitism rate of 2 per cent. There had been therefore a very decided effort on the part of nature to restore the balance. It might be possible to counteract this by maintaining a large laboratory output, but in all probability this would have to be ever-increasing, and as the results had not been so good in 1924 as had been hoped it was decided not to pursue the line of work further. A very fascinating possibility of effecting the control of the fly had been explored, which by itself had hardly proved radical enough, though it might have distinct value as an adjunct to other measures.

The value of the systematic dipping of an animal in arsenical solution of the usual strength (arsenite of soda 0·08 per cent. of arsenious acid) as a measure against tsetses and other insects biting it, an experiment initiated by Bevan in Rhodesia was tested. The rationale of the experiment lies in the fact that arsenic tends to be taken up by the superficial layers of the skin and to be absorbed into the blood, so that there would seem to be a possibility that a prejudicial and even lethal effect on biting insects might ultimately be produced. The result was entirely negative.

Glossina, certain mosquitoes, tabanid flies and ticks allowed to bite a goat that had been dipped thrice weekly over a period of three months seemed to be entirely unaffected, the tick (*Ornithodorus moubata*), indeed, breeding freely after more than one meal off the animal.

A further possibility—that of administering arsenic in gradually increasing doses to an animal over a long period of time with the idea of raising the content of the drug in its blood to a degree that it would have a lethal effect on biting insects—was investigated. The outcome was again negative, though, owing to one's repeated absences from headquarters, some uncertainty prevails as to the amount of the drug received by the animal, the administration being necessarily entrusted to native assistants.

The distribution of the tsetse-fly was studied in late July and early August in the Dowa and Lilongwe districts. In this region there had been for the past twelve years a steady advance of the fly from the north, from Rhodesia into Kasungu, thence into Dowa, and more recently into the salient of Lilongwe, between the Bua and Nambuma Rivers. A careful survey of the fly area in these regions having been made, a scheme, based very largely on the control measures applied by Mr. Swynnerton with such conspicuous success in Tanganyika territory, was submitted to the Administration. It consists, briefly, of:—

(*a*) The clearing of a wide strip of country across the line of advance of the fly.

(*b*) Intensive native settlement along the strip.

(*c*) Agricultural development of the strip and its gradual extension.

(*d*) Organized bush firing in the late dry season.

During November, when this fly area was again studied, an attempt was made to conduct an experiment in bush firing on a large scale against the pest. A full report on the subject was duly submitted to the Administration.

With regard to the malaria problem, the inquiry into the factors possibly involved in the causation of the annual epidemic rise of endemic malaria, which is so regular a feature in East Africa towards the close of the rains, was continued. The validity of the conclusion reached during the previous tour, that a very distinct seasonal occurrence of *Anopheles costalis* is probably the primary cause, received further support from a mass of data obtained during 1925, which again show that this anopheline was almost absent in the lower levels in the dry season, but was overwhelmingly abundant by the late rains, the other common species, *A. funestus*, showing no numerical increase throughout the year.

A study designed to ascertain the particular species of malaria parasite present in the peripheral blood of native children, and the phases present month by month throughout the year, was undertaken at Fort Johnston, for it was thought not impossible that there might be a dominance of one or other species correlated with the change of season, climatic conditions changing so very considerably, and that an increase of the forms of the parasite infective to anopheline mosquitoes might be associated with the numerical increase of the insects taking place by the late rains. It was hoped that it might be possible to secure for examination specimens of the blood of 30 selected native children, carriers of malaria, the same month by month, but, though they were brought forward punctually at first, it was impossible later to obtain specimens regularly in many cases, owing to indifference on the part of their parents, though suitably rewarded. During some months, therefore, less than half the number were secured, but these served to show in the case of quartan and subtertian malaria, the former in particular, that the various phases, including those infective to the mosquito, were present in one or other of the children throughout the year. Benign tertian malaria was found on three occasions only in the course of this and other investigations, in May, July and August, cold season months, concomitant with subtertian in a child who had previously shown quartan infection also; in July, again, with concomitant subtertian in a second child who had previously shown the same mixed infection, and in November, late dry season, in pure culture in a child whose antecedent history as to malaria was unknown.

A study of the amount and kind of malaria prevailing at various altitudes among the native community, with special reference to children possessed of all, or at least the majority of their temporary teeth, was initiated; the topographical distribution of anopheline mosquitoes being studied at the same time. Data obtained at the different elevations show striking contrast, and should have especial value in that there is very little tendency for native women with children to move from place to place. Thus in regard to South Nyasa district, in the Shire Valley—an elevation of about 1,600 feet—25 out of 50 specimens of the blood of native children examined in February, the late wet season, were positive as to malaria, 13 showing quartan infection; 5 subtertian; 4 a mixed infection; and 3 an infection undetermined. In the same locality in October, late dry season, the blood of 15 out of 34 examined was positive—10 with quartan, 3 with mixed quartan and subtertian and 2 with an infection undetermined. The anopheline vectors, *A. funestus* and *A. costalis*, were here abundant during the wet season, the latter being practically absent during the drought.

Colonial Medical Reports.—No. 196.—Nyasaland Protectorate (*continued*).

In regard to lake shore malaria, in the dry season with *A. funestus* only occurring sparingly, 2 specimens out of 33 showed parasites in the one case quartan and in the other benign tertian. In the hill country at Chowe's, at an elevation of 3,000 feet, 24 specimens of blood taken in the very early rains in December were entirely negative, *A. rhodesiensis* being the dominant anopheline, though by no means abundant, and *A. pretoriensis*, *A. funestus* and *A. costalis* occurring very sparingly. At Dowa, a rather higher elevation, about 3,800 feet, 59 specimens out of 60 taken at the same season in the early rains were negative, the exception being a quartan infection. Here none of the anophelines mentioned were obtained, but a species as yet undetermined but differing from *A. funestus* in its possession of bands on the legs, occurred in very great abundance.

A mass of data bearing on the bionomics of mosquitoes was obtained. A point of interest among them was that *Stegomyia argenteus* (*fasciata*) can not only sustain life, but will actually breed on a diet of reptilian blood.

The following papers were published during the year:—

(*a*) "An Attempt to Control *Glossina morsitans* by means of *Syntomosphyrum glossinæ*, Waterston," in the *Bulletin of Entomological Research*, vol. 15, January, 1925. (*b*) "The Seasonal Habit of the Common Anophelines of Nyasaland," in the same journal, vol. 15, April, 1925.

Appendix II.

Some Observations of Intestinal Parasites of Natives at Mlanje.

In the course of routine examination of fæces from natives attending Mlanje native hospital, either with signs of "dysentery," or in whose cases stool examination might assist diagnosis, so many different parasites were found that it seemed likely to be useful to extend the examination to normal individuals, with a view to obtaining information of the degree of infestation of the natives with intestinal parasites.

Thirty examinations of patients' stools having been made, an equal number from natives in normal health was taken for comparison, the police, warders and hospital attendants providing the specimens.

The material in each case was collected in special fæces-collecting pots, and was examined as soon as possible, usually within a few minutes of leaving the body and only very exceptionally after standing more than one hour.

The usual method for examination of fresh stools was used, viz., on a slide, in a drop each of normal saline and Gram's iodine (double strength) placed at suitable distances apart, an emulsion of the stool was made and covered with a cover-glass.

Each preparation was systematically searched, first for ova, &c., under the $\frac{2}{3}$ in. objective, any finding being confirmed under $\frac{1}{6}$ in., and then under $\frac{1}{6}$ in. for identification of entamœbæ, cysts, &c.; the staining effect of the iodine in some cases facilitated identification of cysts.

The following species were found:— *Entamœba histolytica*, free forms; *Entamœba histolytica*, cysts; "Entamœba"; "Cysts"; *Entamœba coli*, cysts; *Iodamœba butschlii*, cysts; *Giardia intestinalis*, free and cysts; Other flagellates, free; *Ascaris lumbricoides*, ova; *Ankylostoma duodenale*, ova; *Strongyloides intestinalis*, larvæ; *Schistosoma mansoni*, ova; *Tænia solium*, onchospheres; an Acarus (Tyroglyphus species).

In some cases, even in the iodine preparation, it was impossible to diagnose with certainty the species of a cyst as in the case of uni-nucleate cysts or when the nuclei could not be seen clearly enough to be counted; these have been recorded as "cysts."

In two cases, also, entamœba were present but presented insufficient characters to enable them to be identified certainly as *E. histolytica*, though this was suspected; they were therefore recorded as entamœbæ. But as in each case there was rapid recovery under emetine treatment, thus proving them clinically to have been *E. histolytica* infections, they have been included in the analysis of "dysentery" cases as amœbic dysentery.

An analysis of cases of "dysentery" based on both stool findings and clinical response to treatment records 18 cases: 8 cases of amœbic dysentery; 7 of schistosome dysentery; 2 of bacillary dysentery; 1 uncertain.

This analysis shows a great preponderance of amœbic and schistosome dysenteries over bacillary, and this is no doubt actually the case; but it must be borne in mind that the former type tend to be chronic infections and the latter acute, so that there is probably less chance of bacillary cases being seen at hospital owing to their inability to travel.

Diagnosis of bacillary infections must also be mainly clinical at present, for lack of cultural facilities, though the cell picture is of some assistance.

Helminth infections, based on the combined previous examinations, give the following results:— *Ascaris lumbricoides*, 21 cases; *Ankylostoma duodenale*, 17 cases; *Schistosoma mansoni*, 8 cases; *Strogyloides intestinalis*, 4 cases; and *Tænia solium* 4 cases.

The above must be regarded merely as minimal figures by reason of the method employed; had a concentration method been used much higher figures, for *Ascaris and Ankylostoma* at any rate, would undoubtedly have been obtained.

It is interesting to note that no ova of *Trichuris trichiura* were found.

The results obtained from the examinations are of sufficient interest to warrant the continuation of the work on a larger scale, chiefly to extend the information regarding the distribution of infections of public health importance, viz., "dysenteries" and hookworm; other parasites also to be noted for their general interest.

It is hoped that it will be possible to do this during the present year.

Appendix III.

Further Notes on Pellagra in Nyasaland.

Treatment by Thyroid Gland Tablets.—Over 100 pellagrins were treated with thyroid gland tablets during the year 1924, and out of this number there were only 8 recurrences during 1925. Two grains of thyroid extract were given to each patient once daily, in tabloid form.

Occurence of Pellagra in the General Population.—Three lunatics were admitted to the asylum with the disease well marked, and within two months from the date of their admission 9 fresh cases occurred in other inmates. One prisoner commenced his sentence with the disease. Two patients—one a woman who had been operated upon for an extra-uterine pregnancy, and the other a boy who was suffering from cretinism—developed the disease two months after admission into the Native Civil Hospital.

About 100 cases were noticed among natives in the district, who had not applied for treatment.

Period of Greatest Incidence of Disease.—The maximum number of cases occurred during the month of August.

New Symptoms Noted.—A feeling of dizziness particularly marked on rising in the mornings.

Result of Blood Examinations.—Forty blood examinations were made, and in all cases there was a reduction in the number of red cells, varying from 500,000 to 1,000,000. The percentage hæmoglobin varied from 40 to 70. A marked eosinophilia was present in most cases.

Adequacy of Prisoners' Diet.—The calorific value of the diet was found to be quite adequate, and averaged 3,000 calories per prisoner per diem. Fresh vegetables were issued every day.

Investigation of Possible Insect Carriers of the Disease.—Several prisoners with pellagra gave a history of having been bitten by a small fly, previous to the onset of the condition. Some of these insects were captured and examined for me by Captain C. Smee, Entomologist to the Agricultural Department, Nyasaland Government. He reported that they were flies of the Simuliidæ family. On further investigation in the fast-flowing streams in the vicinity of the prison, numerous larvæ and pupæ were found, most plentiful during the month of June. There were points both in favour and against Simulians carrying the disease.

F. W. Dry, Entomologist, Kenya Colony, describes what he terms simulian disease in the *Bulletin of Entomological Research*, vol. 12. The disease described bears a resemblance to pellagra, e.g., "The chief symptom is that the skin is in folds. Many of the affected people I saw were able to carry on their usual activities, but some looked to be in quite a feeble condition. Poor sight or even blindness is stated to be caused by the disease occasionally. I obtained slides from three men who had lived in the infested country, and said they had had the disease for about 40 years, and 20 per cent. eosinophilia was found in the blood of each of the three individuals."

Influence of Diet in the Ætiology of the Disease.—Diet appears to be only important in pellagra in so far as food deficiency, with absence of vitamin C content and carbohydrate excess, lowers bodily resistance.

Enlargement of the Parotid Gland.—No enlargement of the parotid gland has been noticed in the series of pellagra cases that have come under my observation.

Appendix IV.

Some Notes on the Treatment of Yaws in Nyasaland.

Yaws has for years been prevalent in the low-lying area bordering the lake shore. Prior to the establishment of the rural dispensaries little was done to combat the disease, but during the years 1922-3-4 the dispensaries were supplied with Castellani's mixture, and a considerable number of natives were treated, both at the dispensaries and in their villages. The results, on the whole, were disappointing, particularly in regard to the tertiary cases; the secondary cases derived considerable benefit, but there were many relapses and imperfect cures.

In August this year treatment by intramuscular injection of 10 per cent. solution of sodium bismuth tartrate was commenced in two particular areas—at Mua and Ntakataka. At Ntakataka treatment was carried out by a native dispenser who was not very reliable, either as regards his records or his methods; at Mua by the Fathers and Sisters of the Roman Catholic Mission who were very enthusiastic and kept accurate records. The results have been most successful, and the natives, once they realized the value of the new treatment, flocked to the dispensaries. No relapses of apparently cured cases have so far occurred, and there seems to be very little doubt that by extending this treatment to other areas the disease could be entirely eliminated. Usually, in any scheme for the treatment of disease on an extended scale, the chief difficulty is with the natives themselves, who will not voluntarily come up for treatment and run away when they are offered treatment in their own villages; but in this case the results are so immediate and the method so free from pain or the necessity for any self-denial that patients appear at the treatment centres with as much alacrity as if they were about to receive their wages.

Cases Treated.

At Mua 382 males and 429 females were treated, at Ntakataka 86 (sex not recorded), and at Dedza 1 male and 1 female.

The large majority of these cases were secondary, but there were several cases of chronic deep ulcers of the legs, which were probably due to yaws and which yielded rapidly to treatment. One striking case of tertiary yaws, in which bone symptoms were a prominent feature, the patient being almost crippled, improved at once under treatment; the pain disappeared and the man looked and declared himself well after the third injection.

Colonial Medical Reports.—No. 197.—Trinidad and Tobago.

ADMINISTRATION REPORT OF THE SURGEON-GENERAL FOR THE YEAR 1925.

Port Health Work.

Quarantine was maintained against Venezuela and Brazil during the whole year; against New York for two months on account of small-pox, and against Cayenne from July to December on account of alastrim.

The number of ships visited was 1,008; 460 were steamers, and 548 sailing vessels, mostly sloops from Venezuela.

Fumigation and disinfection was done in 662 vessels, while 503 packages of baggage were fumigated.

During 1925, 5,597 passengers and 36,794 crew —total 42,391—were inspected; of these 1,632 were kept under surveillance.

Hospitals, Dispensaries and Venereal Clinics.

There is in general a steadily increasing demand on the services of these. In 1910-15, the average number of patients in the three colonial hospitals were as follows: 278, 105 and 33, whereas in 1920-25 the corresponding figures are 338, 135 and 48. Similarly in the six district hospitals the total was 124 in 1910-15, and 159 in 1920-25.

The gradual extension of health offices, principally in the southern and western districts, to meet the spreading population in more recently settled areas has led to a large increase in out-patient treatment. The reorganization of the health office in Port of Spain and removed to the Colonial Hospital as an out-patient department in 1921, has had similar results. Whereas in 1916 out-patients attending all health offices numbered 57,000, in 1925 they numbered 88,000.

The training of nurses continued, special attention being given to this important work. The course for medical and surgical nurses is three years, and for midwives two years, of which the greater part is spent in the general medical and surgical wards of the hospitals.

Fifty-seven candidates were presented for examination, and 41 passed.

At the Colonial Hospital, Port of Spain, the X-ray equipment was brought up to date and put in commission; the administration block redivided to facilitate emergency work; the laundry was extended, and the constant hot water supply apparatus renewed.

At the Colonial Hospital, Tobago, electric light and a piped water supply has been installed throughout.

In the district hospitals, the following improvements were made: St. Joseph, sewerage installed in place of pail system; Tacarigua, sewerage extended to all hospital buildings, and laundry enlarged; Arima, renewal of electric light batteries; Couva, a new concrete cistern and a new mortuary; Princes Town, pipe water installed and sewerage in place of pail system.

Up to 1922 it had been found difficult to maintain an adequate quantity of milk of satisfactory purity; in consequence large quantities of condensed milk were used, especially at the Colonial Hospital, Port of Spain.

Since 1922 the Director of Agriculture and his officers have kindly extended the milking herd at the Government farm until, in 1925, a full supply of high-grade milk was available, not only at the colonial hospitals, but also at the other medical institutions.

This has raised the cost of food per head per diem by 65 per cent.

Dental clinics were opened for the first time this year at the colonial hospitals, Port of Spain and San Fernando. At these 612 people were treated. Development will gradually take place according to the results of experience.

Venereal clinics continued steady work at Port of Spain and San Fernando. Attendance tends to become more regular and continued.

Asylums.

At the St. Ann's Lunatic Asylum there is a steady general tendency towards a reduction in numbers.

Every effort is made to obtain patients for institutional treatment early in the disease, while physical condition is still good. As a result of this policy long continued, the recovery rate each year is a satisfactory one.

The leper asylum is still divided, part being at Chacachacare and part at Cocorite. In 1926 the building at the former will be completed and the final transfers will take place.

The daily average is at present decreasing

The increase reached a maximum of 543 in 1919 as a result of the leper ordnance of 1913. Since that year reduction has set in, the average for 1924 being 452, and for 1925 432.

This reduction is due to three causes (*a*) reduction in admissions, now about 100 a year instead of 150-200 a year; (*b*) repatriation of East Indian lepers to India at their request, 147 have been returned between 1921-25; (*c*) discharge of those in whom symptoms of active disease have disappeared—31 such in 1924-25.

Absconding is much reduced, from about 70 to 80 a year to 16 in 1925.

There is now being developed an active and thorough campaign of treatment. This consists mainly of (*a*) specific treatment with hynocarpus oil, (*b*) careful treatment of debilitating diseases, and (*c*) attention to exercise, diet, &c.

The house of refuge continued very full throughout the year. No changes or alterations were carried out in view of the possibility of removal elsewhere.

SCIENTIFIC.

Special investigations beyond ordinary routine work were conducted by the Government bacteriologist into: (*a*) the bacteriology of human and animal fæces in relation to water supplies, including the determination of *Bacillus coli* and *B. aerogenes;* (*b*) the distribution of bovine tubercle bacillus in human beings; (*c*) an outbreak of abortion amongst cattle; (*d*) an outbreak of botulism amongst cattle.

The routine investigations numbered 4,577, of which Wassermann test numbered 1,601, malarial examination 202, Widal tests 985, tubercle sputum 770, diphtheria examination 185, and examination for amœba 127.

In addition 5,593 rats were inspected for plague, with no infection.

Thirty-four thousand six hundred and seventy-one doses of antityphoid vaccine (typhoid and paratyphoid A and B), were made and issued.

Colonial Medical Reports.—No. 198.—Trinidad and Tobago.

ADMINISTRATION REPORT OF THE MEDICAL INSPECTOR OF HEALTH FOR THE YEAR 1925.

POPULATION.

The mid-year population has been estimated by the Registrar-General as 383,422.

BIRTHS.

The number of births registered was 12,701—6,450 males and 6,251 females—equivalent to a birth-rate of 33·12 per 1,000 of population. This rate is slightly below (0·54) that of last year, but is 1·92 above the mean (32·2) for the preceding 10 years.

DEATHS.

The number of deaths registered was 7,888—4,267 males and 3,621 females—equivalent to a death-rate of 20·57 per 1,000 of population. This rate shows a slight increase (0·55) on that of last year, which was the lowest on record, but a decrease of 1·66 on the mean (22·23) for the preceding 10 years.

NATURAL INCREASE OF POPULATION.

The natural increase of population, *i.e.*, excess of births over deaths, was 4,813.

This year's figure, though smaller than the two preceding years, indicates the maintenance of a satisfactory growth of population.

INFANTILE MORTALITY.

Of the total deaths registered 1,708 were of children under one year of age. The infant mortality rate (*i.e.*, proportion of the deaths under one year to the 1,000 births in the same period) was 134·47.

This figure breaks the record of the steady decline of the rate since 1920, but the rise is probably temporary, and due to the more than usual unfavourable conditions during the third quarter of the year.

No branch of the Child Welfare League was opened during the year. The League continued its activities in the following areas: Urban—Port-of-Spain and San Fernando. Rural—St. James, St. Joseph-Caroni, Sangre Grande, Toco, Cedros, Tobago.

INFECTIOUS DISEASES.

ENTERIC FEVER.

834 cases were notified, with 205 deaths. The summary of the distribution for the last five years shows a marked increase in the prevalence in the southern half of the island which has hitherto been relatively lightly affected.

The seasonal incidence shows that the majority of the cases occurred during the wet season following the mean curve as plotted out for the five years 1909-1923.

In Port-of-Spain there was also a return to the mean—the months of highest prevalence being January, with 26 cases, and September, with 31 cases.

Investigation of the distribution showed that this year's high total was principally due to local outbreaks in new areas following on the introduction of infection from localities in which the disease is more or less endemic. The measures of prevention detailed last year were continued. Further experience has strengthened the opinion expressed last year of the value of preventive inoculation.

There is ample evidence that in outbreaks in rural districts where families housed in the usual labourer's hut live or sleep in one room without any attempt at the separation of the sick from the healthy, this measure is of the greatest service in controlling the spread of the disease.

The importance of early notification is generally recognized, but the wide prevalence of malaria during the period of the seasonal prevalence of enteric fever, and the social and physical circumstances naturally present in rural areas with a scattered population, hamper its application. It is evident, however, that there is improvement in this direction.

Colonial Medical Reports.—No. 198.—Trinidad and Tobago *(continued).*

TUBERCULOSIS.

There were 519 cases of pulmonary tuberculosis and 439 deaths registered. Of the total notifications 186 were from Port-of-Spain and 270 from the other towns and large villages in the following order: San Fernando 49, St. Joseph 31, Diego Martin 30, Couva 26, Erin-Siparia 26, Princes Town 23, Manzanilla 22, Tacarigua 18, Tobago 16, Ortoire-Moruga 15, and Naparima 14. 25 cases of tuberculosis other than pulmonary were notified.

PNEUMONIA.

399 cases with 219 deaths were notified—113 from urban and 277 from rural districts. The cases occurred generally over the Colony throughout the year.

CHICKEN POX.

60 cases were notified—35 from urban and 28 from rural districts. There was no death.

DIPHTHERIA.

48 cases with 5 deaths were notified—21 from urban and 27 from rural districts.

PRINCIPAL CAUSES OF DEATH.

MALARIA

retains its position as the chief cause of death and accounted for 791 deaths. This figure, though 34 above that of last year, is 29 below the mean of the preceding six years.

DIARRHŒA AND DYSENTERY.

During the months of June and July there was widespread prevalence of diarrhœal diseases. The condition was characterized by acute onset, absence of or only slight rise of temperature, profuse diarrhœa—the stools generally water and frequently bloodstained, and caused many deaths, chiefly among children and elderly persons. It appeared to be related to drinking water, but began at the end of the dry weather and before the onset of the rains, and occurred in districts with different sources of supply, *i.e.*, streams, wells and ponds without apparent special incidence in relation to any particular source.

The total mortality from these two causes for the year shows a substantial increase over that of last year. The unfavourable effect of the outbreak is apparent in the high mortality figures of the third quarter of the year.

PUBLIC HEALTH.

LEGISLATION.

The following bye-laws were approved by the Board and confirmed by the Governor in Executive:

Bye-laws made by the Port-of-Spain City Council with respect to match factories and workshops.

Ophthalmia neonatorum was declared an infectious disease under section 100 of the Public Health Ordinance No. 15 of 1915 on May 21, 1925.

TRAINING OF SANITARY INSPECTORS.

A course of lectures was given from May to July and on its termination a tutorial class with demonstrations covering the subjects. A qualifying examination was held in September; 9 candidates sat; 5 qualified and were awarded the certificate of the Board.

ANTI-MALARIAL WORK.

Quinine in tablet form at the low cost of 1 cent for 5 grains was placed on sale at post offices in country districts. The Postmaster-General and his staff have taken a keen interest in this measure, and through their ready co-operation large quantities of the drug have been sold.

At the same time and as an educative effort a lecture written by the Hon. Surgeon-General and illustrated by lantern slides has been given at several centres of population by the Medical Inspectors and Medical Officers of Health.

ANKYLOSTOMIASIS CAMPAIGN.

There has been no interruption of this work. Two units, of two men each selected from the staff of the Rockefeller Commission, were organized and during the year have worked in the districts of Diego Martin, Cedros and Toco. These four officers are qualified Sanitary Inspectors and undertake sanitary duties in co-operation with the Sanitary Inspector of the district.

THE MODEL VILLAGE OF BRIGHTON-LA BREA.

"The usual high standard of sanitation was maintained in the bungalow area during the year. During November and December there was an extension of the New Jersey Model Village, one bachelors' barracks and six family barracks having been built. The New Jersey Commissariat was also enlarged, and a model electric bakery added—whilst the facilities for recreation and enjoyment were enhanced by the addition of a cycle track and football and cricket field. The New Jersey Village now consists of 36 cottages, 15 family barracks and 11 bachelors' barracks. The general health of the residents has been very good, and with the exception of the usual malarial epidemic during August and September there has been comparatively little sickness of any kind." (Extract from Dr. de Verteuil's report.)

WATER SUPPLY.

The Tobago Waterworks, which were in full operation during the latter part of the year, was formally opened by His Excellency the Governor on April 21, 1926. The Sangre Grande Waterworks were extended to the Manzanilla district.

VENEREAL DISEASES.

The Venereal Clinics at Port-of-Spain and San Fernando continued in operation throughout the year—a summary of their work is given below.

SUMMARY.

The record of the year was somewhat disappointing, but the decline from the record of last year is

slight, and a broad survey supports the opinion that this is temporary.

SUMMARIES OF REPORTS OF THE MEDICAL OFFICERS OF HEALTH.

Diego Martin District.

The district shared in the typhoid outbreak, 50 cases having been reported. The usual measures were taken for prevention, including inoculation, which I am informed was extended to the schools. No other disease was sufficiently prevalent to merit mention.

Overcrowding, primitive customs and filthy habits favour the spread of infectious diseases.

Efforts are being made for the provision of sanitary cowsheds, and shops are regularly inspected to ensure wholesomeness of food for human consumption. The sale of vegetables and fish is conducted under shop shelters in St. James. It would be advisable to provide an independent structure for that purpose.

Water appears to be sufficient and of good quality. It is partly pipe-borne, as in the larger villages and the suburb of St. James, or partly collected from springs and wells. Supply is normally constant, but becomes intermittent during a drought. The streams are not perennial. The usual pollution by clothes washing, &c., obtains.

St. Joseph District.

Infectious Diseases.—The following cases were notified: Enteric fever 80, pulmonary tuberculosis 27, pneumonia 23, chicken pox 3, diphtheria 5, ophthalmia neonatorum 2.

There were no infectious diseases to any extent with the exception of enteric. Of this there were 80 cases as compared with 91 last year. A point of interest is that *the majority of the cases occurred in the low-lying districts* of Caroni, Barataria, El Socorro, which are also the most thickly populated and least sanitary areas.

3,039 inoculations against enteric were done during the year.

Sanitation.—The sanitary work was efficiently carried out by the Sanitary Inspector, and there is quite appreciable improvement in latrine and cowsheds.

Privy Accommodation.—Cesspits are in general use. 325 fresh pits were opened during the year; 17 concrete pits were emptied and disinfected.

Anti-Mosquito Measures.—These were carried out within the capacity of the funds available and the education of the people in this direction continued. Pools and drains were regularly oiled.

Cowsheds.—Twenty-five were concreted, making a total of 115 concreted cowsheds in the district.

Arima Rural District.

Twenty-four of the total of 76 deaths recorded were children under five years of age. The chief causes of death were disease of the alimentary system 14, disease of the respiratory system 11, malaria 9, disease of the kidneys 6, dysentery 4, tuberculosis, pneumonia and cancer 3 each.

Infectious Diseases.—The cases notified were: Enteric fever 2, pneumonia 5, tuberculosis 2, diphtheria 1.

Other Diseases.—Malaria was prevalent throughout the year, but least so during the dry season. In August and September a good many cases of malignant malaria were seen.

Yaws seem to be gradually dying out. Many cases of chronic ulcers were injected, under the supposition that yaws may have been an ætiological factor, with satisfactory results.

Ankylostomiasis continues very prevalent.

Privy Accommodation.—Most of the time of the Sanitary Inspector is taken up with this work. 345 new cesspits were built during the year, and a large number of those already existing were cleaned and disinfected.

Anti-Mosquito Measures.—The usual minor measures were carried out.

St. Andrew District.

General Health.—Less favourable than in previous years.

Infectious Diseases.—Typhoid fever 78, pneumonia 51, consumption 17.

Typhoid Fever.—The number of cases in the previous year was 28. To a considerable extent the increase was due to the introduction of cases from outside the district, viz.: Tunapuna, San Juan and Las Lomas. 34 cases were definitely traced to these sources.

Preventive inoculation was largely employed. During the year 6,134 persons received 13,329 anti-typhoid inoculations.

Other Diseases.—Dysentery—103 cases against 71 in the previous year. The cases were not limited to any one part of the district, but were scattered about indiscriminately and occurred more or less throughout the year.

Malaria.—The chief disabling disease. 2,823 cases were treated, the greatest number occurring in the months of July, August, September and October.

Influenza.—75 cases of which 57 occurred in the months of January, February, March and April.

Pneumonia.—51 cases, more or less distributed throughout the year.

Food and Drink.—Conditions as regards milk and food for human consumption were normal.

Water Supply.—No difficulty in obtaining water anywhere. The Sangre Grande Waterworks were extended to Manzanilla—a boon to the inhabitants of that part of the country.

Drainage.—The drainage of Sangre Grande Town is in the same deplorable state.

Privy Accommodation.—Pit closets chiefly.

A new dumping ground was opened on January 1, 1926, at a further distance from houses to lessen the nuisance of flies.

Chaguanas District.

General Health.—There was no epidemic or any case of disease unusually grave.

Infectious Diseases.—Five cases of enteric fever occurred at Charlie Village and Bejucal and two cases of pulmonary tuberculosis at Endeavour, but there was nothing of an alarming nature.

Other Diseases.—Malarial fever and ankylostomiasis were generally prevalent.

St. David District.

General Health.—There were no circumstances affecting or threatening the health of the district.

Infectious Diseases.—The following cases were notified: Pneumonia 2, pulmonary tuberculosis 6, chicken poz 2, diphtheria 1, enteric fever 2, ophthalmia neonatorum 1.

Both cases of enteric fever occurred at Cumana. One case arrived in the district of San Juan suffering from continuous fever; the other and later case never left the district. All the contacts were inoculated.

The case of diphtheria and all the cases of the pulmonary tuberculosis were sent to the Colonial Hospital.

Water Supply.—There are no waterworks in the district. Rain and river water is used. The quality throughout is good and at Matelot and Grande Riviere the supply is abundant all the year round. There is a diminishing supply at Sans Souci and Cumana during the dry season, at which time the people depend on the Betty and Sans Souci rivers and the Tompire River. At Toco village the people are badly off for water during the dry season. They depend on a well and the Basin Galape River.

Drainage.—Toco village especially calls for improvement by way of the opening of the mouths of such rivulets as (1) Patience Ravine, (2) Garcie Ravine, (3) El Toco River.

Privy Accommodation.—The privy cesspit system in the district is fairly good. There are approximately 970.

Disposal of Refuse.—In Toco Village a scavenging cart is employed to collect and dump the refuse into the sea.

Gran Couva District.

November 24 to December 31, 1925.—During the period no cases of infectious disease were seen. The district is hilly with few or no collections of standing water.

Naparima District.

Enteric Fever.—The outstanding feature of the year was the increased prevalence of enteric fever. 102 cases were notified as against 32 in 1924. The measures adopted for the control of the disease were —(1) removal of cases to hospital; (2) improved latrine accommodation and disinfection of premises generally; (3) inoculation.

The water supply is very unsatisfactory, the chief source of supply being ponds.

Princes Town District.

Water supply of the Princes Town Waterworks is good in both quality and quantity. In areas beyond this water supply rain water is collected during the rainy season in pails, barrels, coppers, tanks, cisterns, &c., which in the absence of screening and fishes serve as admirable breeding places for mosquitoes. In the dry season ponds and shallow wells supply the water, the quality and quantity of which are unsatisfactory.

Closet Accommodation.—Number of privy cesspits increased by 252 new privies during the year. A few w.c.'s and septic tanks exist at Ste. Madeleine, Reform Estate, Pointe-a-Pierre, and Princes Town.

Milk Supply.—The bye-laws are being enforced. 192 visits of inspection were made to dairies and cowshads during 1925. The number of registered dairies and cowsheds was 52. 51 licences were issued to vendors of milk.

Typhoid Fever.—The majority of cases of typhoid fever could be assigned to impure supply in the areas not within the reach of the Princes Town Waterworks. The highest number of cases occurred during the month of December and the areas affected were the villages of St. Mary and 5th Company.

Fever cases occurred at Cedar Hill and Chirkoo Village, where extensive inoculations were carried out in 1924.

Inoculation of contacts with the necessary isolation of cases and disinfection of premises and clothing were carried out.

Malaria.—During the year the Government placed at country post offices quinine tablets for sale to the public at reasonable prices, one 5 grain tablet costing one cent.

Lantern lectures were delivered by the Senior Assistant Medical Inspector of Health explaining the prophylaxis and treatment of malaria.

The use of quinine was strongly advocated.

Ortoire-Moruga District.

(*a*) General prevalence of bacillary dysentery from May to September, incidence greatest at New Grant, Monkey Town and Torrib Trace.

(*b*) *Water Supply.*—Princes Town Waterworks up to 11½ mile post on the Naparima-Mayaro Road. In other parts of the district ponds are the sources of supply, quantity and quality unsatisfactory.

(*c*) *Infectious Diseases.*—There were 26 cases of enteric fever and 18 of pulmonary tuberculosis.

(*d*) *Chief Causes of Death.*—Malaria, dysentery, chronic nephritis, senility, congenital debility, gastro-enteritis, pulmonary tuberculosis and ankylostomiasis.

Of these malaria is *facile princeps*. The next 5 diseases occupy an intermediate position between malaria and the last two, viz., pulmonary tuberculosis and ankylostomiasis, which are each responsible for about half as many deaths as malaria claims.

Erin-Siparia District.

(*a*) The conditions favourable to the existence of malaria are present in all parts of this large district.

Ankylostomiasis, though prevalent, has not been responsible for many deaths.

(*b*) 34 cases of enteric fever were reported. Of these roughly half were genuine cases. Inoculation of contacts was effected wherever possible.

There were many cases of dysentery in the Penal area.

(*c*) Water Supply is inadequate and unsatisfactory.

(*d*) The work of the satisfactory disposal of sewerage has been carried out with some vigour. The privy accommodation is much in advance of last year.

(*e*) *Scavenging* has been systematically carried out at Siparia, Oropouche, Fyzabad, Erin and Penal.

Brighton-La Brea District.

Brighton.—The usual high standard of sanitation was maintained in the bungalow area at Brighton during the year. During November and December there was an extension of the New Jersey Model Village, one bachelors' barracks and six family barracks having been built. The New Jersey Commissariat was also enlarged and a model electric bakery added—whilst the facilities for recreation and enjoyment were enhanced by the addition of a cycle track and football and cricket field.

The New Jersey Village now consists of 36 cottages, 15 family barracks, and 11 bachelors' barracks.

The general health of the residents has been very good, and with the exception of the usual malaria epidemic during August and September there has been comparatively little sickness of any kind.

La Brea.—There has been a marked change in the general appearance of the Government New Village during the year owing to the construction of numerous houses in accordance with an agreement in Corbeaux Town and Dundonald's Village—Ladysmith, where several so-called houses have been allowed to tumble to pieces in consequence.

The hopes once entertained of an early reconstruction of Corbeaux Town and Ladysmith have not yet been realised, and these filthy villages still stand as disgraceful landmarks of the woeful lack of sanitation once prevalent in bygone days all over the colony, landmarks made all the more prominent in contrast to the neighbouring Government New Village and the Model Village of New Jersey.

Infectious, &c., Diseases.—Malaria was endemic as usual, but became epidemic from July to November.

Measles and mumps were very prevalent from March to September.

Water Supply.—The wells at the Government New Village have been cleaned and connected up together and a fairly plentiful supply of good potable water is now obtained.

A small pipe leading from the wells to a site near the R.C. schoolhouse would easily supply the New Village and Corbeaux Town residents and should be an inexpensive undertaking.

Privies.—Very useful work has been carried out by the Sanitary Inspector. 194 cesspits and 130 privies have been built during the year.

Cedros District.

Malaria and ankylostomiasis are the two most prevalent diseases.

The district abounds in lagoons and swamps of large areas.

Water Supply.—The population depends on ponds, tanks, barrels. In the dry season there is much hardship. This district is badly in need of a constant source of satisfactory potable water.

Sewerage Arrangements.—This year has seen much improvement in the privy arrangements. Many new cesspits, 50 have been constructed according to the model supplied by the Central Board of Health. Few pails remain. With the disappearance of the pail privies, much of the beach pollution, which has been a great nuisance in the past, will happily cease.

Infectious Diseases.—Pulmonary tuberculosis 8, lobar pneumonia 3, ophthalmia neonatorum 2. There were no cases of enteric fever.

Dysentery.—A severe outbreak occurred in August and September, mainly in Bois Bourg. The drinking of pond water appeared to have a casual relationship to the outbreak.

Hookworm Campaign.—From October two hookworm officers of unit B. have been operating with the district hospital as headquarters. The work has been progressing very favourably, the inhabitants availing themselves readily of the opportunities for examination and treatment. The whole of Bonas and Ste. Marie Villages had been treated by the end of the year.

Scarborough District, Tobago.

The principal causes of death were—Malarial fever 15, cardio renal 17, senile and associated conditions 22, pneumonia 11, pulmonary tuberculosis 4, cancer 9.

Infectious Diseases.—4 cases of enteric fever came under observation. Total admissions to hospital were 6, so that the figures for the whole island, even admitting that a few cases might have escaped detection, were very satisfactory. For 3 previous years 50, 37 and 29 cases were treated.

Our routine measures, the only that appear worth carrying out, viz.: (1) immediate isolation in hospital, (2) inoculation of contacts and others who might be induced to come forward.

Other Diseases.—Malarial fever incidence remains undiminished. Two cases of malignant malaria occurred in the Scarborough District. The distribution of quinine from the post offices does not appear to have affected the situation to any appreciable extent. An anopheles survey has been carried out and breeding places charted, but the situation is a changing one from year to year, and favourable results can hardly be expected with the small means at our disposal.

Colonial Medical Reports.—No. 198.—Trinidad and Tobago *(continued).*

Ankylostomiasis.—Severely infected cases have remained a rarity in the district. All suspected adult cases are now treated with CCl_4. Although I have used maximum doses, I have seen no ill results.

Yaws.—The use of the sod. bism. tart. preparation was continued. Recurrences do occur, but in no larger a proportion of cases than with N.A.B. It is well tolerated by children, in whom is rarely seen a case of stomatitis, although there have been a few troublesome cases of the latter in adults.

Sanitation.—The usual rounds of inspection have been assiduously carried out by the Sanitary Inspector during the year.

Food and Drink.—Supervision of milk supply was confined to inspection of milk cows and vendors. Shops, bakehouses, &c., have been regularly inspected.

Water Supply.—It is a pleasure to record that a pipe-borne water supply has been in operation throughout the district during the latter half of the year.

Drainage and Anti-Malarial Measures.—During the year only minor anti-malarial work has been possible. A small section of drain in the town has been concreted. It is recommended to continue this work as a useful permanent measure. The neighbouring swamps and gullies have been attended to by the prison gang and oiling carried out wherever indicated.

Privy Accommodation.—The improvement of privies in accordance with the new Privy By-laws is being systematically carried out.

Roxborough District, Tobago.

General Health.—There was no epidemic prevalence of infectious diseases.

Infectious Diseases.—Three cases of enteric occurred during the year.

Other Diseases.—Malaria and yaws are the most prevalent diseases.

Sanitation.—Minor anti-malarial measures were carried out throughout the year.

Plymouth District, Tobago.

General Health.—There has been no epidemic in the district.

Infectious Diseases.—Pulmonary tuberculosis and enteric fever appeared occasionally; the latter never gave cause for worry.

Other Diseases.—Whooping cough was prevalent during the last two or three months of the year. No deaths were due to it.

In hot months there were a few cases of dysentery in adults.

The absence of gastro-intestinal trouble in infants is ascribed to the educational measures propagated by the nurses of the Child Welfare League. There is no doubt that much good work is being done by the League.

Sanitation.—The Sanitary Inspector paid the usual visits to premises, &c.

Food and Drink.—Bakehouses were regularly inspected and bakers have to procure a certificate of fitness of health before they are allowed to engage in the trade.

Slaughtering in country districts is not so easily controlled, some supervision is nevertheless given.

Water Supply.—Part of the district has been blessed with a water supply. It is to be regretted that the promising villages of Mason Hall and Moriah were not included in the scheme.

Drainage and Anti-Malarial Work.—Anti-malarial work due to a pitiful belief in temporary measures gave little result.

Privy Accommodation.—169 new privies built and 177 cesspits were dug. Two schools, the Adelphi E.C. and Parlatuvier E.C., have repeatedly failed to comply with notices served them, and the managers' promises have been repeatedly broken.

Antenatal work is being attempted and already some good has been achieved, many expectant mothers bringing specimens of urine for examination.

VENEREAL DISEASES CLINIC, PORT-OF-SPAIN.

The following are the statistical figures of the Venereal Diseases Clinic at Port-of-Spain for the year ended December 31, 1925: The number of persons dealt with during the year and found to be suffering from (*a*) syphilis, (*b*) gonorrhœa, or (*c*) conditions other than venereal were 1,481 males and 901 females.

The number of doses of (*a*) arsenobenzol compounds was 1,898, (*b*) bismuth preparation 1,148, and (*c*) mercury 1,090. The total number of attendances of syphilitic patients was 4,136. The number of irrigations with potassium permanganate and oxycyanide of mercury was 26,985. The arsenobenzol compounds used were neodiarsenol and neosalvarsan. The bismuth preparation used was sodium potassium bismuth tartrate. The mercury used was mercury cyanide.

The attendance was regular, but there are a fair number of persons who cease to attend before completing the first course of treatment. It is regrettable to state that there were only fifteen syphilitic cases discharged as cured, or at least gave a negative Wassermann reaction after treatment. The injection of sod. pot. bismuth tartrate had to be discontinued on account of the pain and induration it caused, and in a few cases abscess formation. The ill effects after injections of neosalvarsan were not severe. The most frequent sequelæ noticed were vomiting, rise of temperature, and vaso-motor disturbances.

VENEREAL CLINIC—COLONIAL HOSPITAL, SAN FERNANDO.

The Venereal Clinic was opened daily for the free treatment of venereal disease. The Assistant Resident Surgeon attended to the male patients on Mondays and Wednesdays, and to the female patients on Thursdays and Saturdays.

The following diseases were treated: Syphilis,

167 males and 62 females; gonorrhœa, 123 males and 195 females; granuloma, 3 males.

The following injections were given: Intravenous N.A.B., 1,236; intramuscular mercury, 846.

The attendance has definitely improved and patients persevere more in the treatment, the average number of N.A.B. injections per patient being 5·4 and mercury 4. This means that about 75 per cent. of those treated had a satisfactory course of treatment.

Colonial Medical Reports.—No. 199.—Cairo.

REPORT OF THE MEDICAL OFFICER OF HEALTH, CAIRO CITY, FOR THE YEAR 1923.

I.—Vital Statistics.

(a) *Population.*

The mid-year population of Cairo for 1923, as estimated by the Statistical Department, was 791,000, consisting of 721,429 Egyptians and 69,571 foreigners. To this population should be added that of the area around Helwân proper, which is administered by the inspectorate for all public health purposes, except the registration of births and deaths. This population, which has been estimated at 30,230, added to that of Cairo, amounts to 821,230.

(b) *Births.*

During 1923 the total number of births which occurred in Cairo was 41,309. Of this total 40,471 were Egyptian and 838 foreign births. The annual birth-rate was therefore 52·2 per thousand of population, as compared with 53·5 in the previous year.

(c) *Deaths.*

During 1923, a total of 28,806 deaths occurred in Cairo. Of these, however, 650 were deaths of non-residents, leaving 28,156 for Cairo proper.

This gives an annual death-rate of 35·6 per 1,000 of population, as compared with a rate of 34·3 for 1922.

(d) *Infantile Mortality.*

9,495 children under one year of age died during 1923, giving an infantile mortality of 230 per 1,000 births for the whole city, as compared with 239 in 1922 and 220 in 1921. In addition there were 227 deaths of infants coming from outside Cairo and who died in various public institutions.

During the quinquennial period ending with the present year the mean annual infantile mortality rate was 236 per thousand births.

The highest rate during this period was 255 in 1920 and the lowest 220 in 1921.

As regards the various districts of the city the lowest infantile mortality rate occurred in Ezbekiya with 181 infantile deaths per thousand births. Of the 9,495 deaths of children under the age of one year occurring in 1923, 9,410 were deaths of Egyptian infants and 85 of foreigners.

There is a tendency amongst the uninformed to take the view that because hygienic conditions are not better, the health authority is almost entirely to blame for the fearful infant mortality that prevails during the summer months. It is therefore of interest to note the following extract from an article entitled "Summer Diarrhœa in Infancy," by Dr. Pearson, of the Hospital for Sick Children, Great Ormond Street, London:—

Summer Diarrhœa in Infancy.

"The points of general agreement are that bad hygiene, bottle-feeding, and heat all have a positive influence in promoting the disease.

"Children in their first year are the chief sufferers, the highest mortality occurring in the last nine months of this period.

"Although bad hygiene and bottle-feeding exist at all times, yet diarrhœa is only prevalent in the hot months; hence we must regard a high temperature as a factor of great importance. The rise in mortality from diarrhœa occurring yearly in most cities, beginning in July and reaching its maximum in August or September, is very striking. Observations have shown that this increase occurs when the atmospheric temperature becomes sustained day and night above 60° F. (15·6° C.). An exact explanation cannot be given, but probably heat exerts its effect in several ways; first by depressing vitality thus lowering the power of resistance and lessening tolerance for food; and secondly, by favouring the growth of micro-organisms both within and without the body."

If such is the case in the cooler countries of Europe, infantile mortality in sub-tropical countries may always be expected to be very high during the hot season, however great the improvements that may be effected in hygiene. From the second week of May until the last week in October, the temperature did not fall below 15·6° C. The onset of the heat is accompanied by a very sudden enormous increase in infant mortality that decreases later on, although the temperature may still remain high. The most probable explanation of this is that ailing and weakly children at once fall victims and only the stronger children survive until the later summer months.

II.—Infectious Diseases.

The total for all infectious diseases reported during 1923 was 4,780 which includes 106 cases coming from outside Cairo, so that the total for Cairo proper was 4,674, as compared with 4,740 in 1922. Out of this total 3,189 with a mortality of 986 were cases belonging to the eight principal diseases. The remainder include 833 cases of influenza, 97

of whooping-cough, 106 of mumps, 24 of tetanus, 5 of Malta fever, 11 of encephalitis lethargica, 10 of rabies, 50 of puerperal fever, and 295 of chicken-pox. The rate per thousand of population for the eight principal diseases was 3,880, as compared with 3,165 in 1922, whilst the rate of deaths to cases was 30·9 per cent., as against 33·3 in the previous year.

Small-pox.—The total number of cases notified during the year was 28, as against 24 in the previous year. There were 13 deaths from this disease, 10 of which were diagnosed after death. All had been vaccinated, with the exception of one, which was only one month old.

Diphtheria.—The total number of cases recorded in 1923 was 1,418. There were 452 deaths from this disease, all of which were diagnosed after death, with the exception of one. This is an indication that a large number of cases of this disease was never declared but recorded.

Scarlet Fever.—There were 29 cases notified during the year, as compared with 68 in 1922, whilst the number of deaths from this disease was 3.

Diphtheria.—The total number of cases recorded in 1923 was 619, as compared with 418 in 1922. The total number of deaths was 194.

Typhoid Fever.—The total number of cases notified during the year was 969, as against 859 in 1922. The number of deaths from this disease was 242.

Typhus Fever.—The total number of cases recorded during the year was 112, which is the lowest total during the last 10 years. There were 77 deaths.

Relapsing Fever.—There were only 2 cases recorded this year and no deaths.

Cerebrospinal Fever.—There were twelve cases of this disease during the year, as compared with 8 cases in 1922. The number of deaths was 5.

Puerperal Fever.—The total number of deaths from puerperal fever during 1923 was 32, out of which 29 were among Egyptians and 3 among Europeans. There were, however, 28 deaths which occurred within a fortnight of confinement which, if added to the others, make a total of 60. The causes of these 28 deaths are given as: nephritis 1, eclampsia 9, hæmorrhage 4, peritonitis 3, abortion 1, enteritis 1, pneumonia 2, difficult labour 2, septicæmia 2, insanity 1.

Influenza.—The total number of cases notified during the year 1923 was 833, as against 1,461 in 1922. The number of deaths attributed to this disease was 21.

The number of deaths of all respiratory diseases, excluding pulmonary tuberculosis, was 4,423, out of which 1,871 were due to pneumonia, 2,388 to bronchitis, 26 to pleurisy and 138 to other respiratory diseases.

Of the 1,871 deaths from pneumonia, 1,322 were children up to 5 years of age, 154 from 5 up to 15, 166 from 15 up to 35, and 229 from 35 over.

Encephalitis Lethargica.—There were 11 cases notified during the year and the number of deaths from this disease was 6.

Plague.—Three cases of septicæmic plague occurred, the disease having been brought from Suez. Their history is as follows:—

(1) Boab came from Suez February 3, 1923, stayed with a friend, another boab, at Bab el Bahr, and died February 4. The medical officer who examined the body diagnosed tuberculosis.

(2) Boab, the host of No. 1, removed to Bâb el Sha'riya Qism and died on February 12, the death certificate from a private practitioner giving kidney disease as the cause of death.

(3) Brother of (2) died on February 16, the body was seen by the medical officer, who diagnosed typhus on the strength of a hæmorrhagic rash. Thanks, however, to the careful control exercised by the senior medical officer of the epidemic section, the inspectorate became aware of the case and specimens were taken and sent for bacteriological examination with the result that the case was proved to be plague. In the meantime every precaution had been taken and no further cases occurred.

There was also a case of bubonic plague imported to Cairo from Menouf Markaz, which died three hours after admission to the fever hospital.

Colonial Medical Reports.—No. 200.—Bengal.

ANNUAL REPORT OF THE MENTAL HOSPITALS IN BENGAL FOR THE YEAR 1924.

By Colonel R. P. WILSON, I.M.S.,

Surgeon-General with the Government of Bengal (offg.)

Accommodation.

The total capacity of all the mental hospitals in Bengal (including that of the mental observation ward at Bhowanipore and mental ward at the Albert Victor Leper Asylum at Gobra) that were in operation during the year 1924 was 1,147, as against 1,121 in 1923. The increase was due to the fact that the ward for Indian patients at Bhowanipore, which provides accommodation for 26 observation cases, was brought into use from May 1, 1924.

Population.

The total population of the two hospitals at Dacca and Berhampore and the mental ward at

Gobra was 1,172, as compared with 1,186 in the previous year. Their daily average strength was 977·05 (834·92 males and 142·13 females) as against 950·44 in 1923. The maximum number confined in any one night was 1,023 (878 males and 145 females) as compared with 973 in 1923. There was no overcrowding in any institution.

Admission and Readmission.

Altogether 224 insanes were admitted or readmitted during the year, as compared with 213 in the previous year.

The duration of insanity prior to admission was ascertained in 91 cases; it was less than three months in 28 cases, between three and six months in 13, between six and twelve months in 21, between one and two years in 12 and between three years and over in 17 cases.

Discharges and Recoveries.

The total number discharged during the year under report was 123, as against 157 in 1923; of this number, 85 were cured, as compared with 115 in the previous year, their percentage to daily average strength being 8·70, as against 12·09 in 1923. Of the 85 insanes cured, 38 suffered from mania, 6 from melancholia, 1 from circular insanity, 3 from delusional insanity, 4 from insanity due to alcohol, 10 from insanity due to cannabis indica, 22 from dementia præcox and 1 from idiocy.

Sickness and Mortality.

The general health of the patients at the time of their admission was better than it had been in 1923, their daily average sick having been 89·01, as against 116·97 in 1923. There was no outbreak of disease in epidemic form in the Dacca Mental Hospital; while at Berhampore a mild epidemic of influenza broke out in July, causing 63 admissions in the infirmary and only 1 death. The largest number of admissions in all the hospitals was from influenza, viz., 129 (66 at Dacca and 63 at Berhampore). The next highest number was 70 from diarrhœa. Dysentery accounted for 67 admissions and epilepsy for 52.

The mortality was much lower than in 1923, being 5·62 per cent. to daily average strength, as compared with 8·52 in 1923. The actual number of deaths was 55, viz., 12 at Dacca and 43 at Berhampore, as compared with 81 in 1923. Phthisis was the cause of death in 18 cases, senility in 9 cases, all occurred in the Berhampore Hospital. General tuberculosis was responsible for death in 7 cases and diarrhœa in 4 cases in all the hospitals.

Accidents and Injuries.

There was no accident or injury in the Dacca Mental Hospital. At Berhampore a serious accident occurred; a building situated in the outside garden of the hospital having collapsed during a severe hailstorm, a patient met instantaneous death.

There also occurred at Berhampore 7 cases of injury of serious nature, of which 5 were accidental and 2 inflicted by fellow-patients.

Escape.

There was 1 case of escape from the Bhowanipore Mental Observation Ward and 2 from the Berhampore Mental Hospital. A portion of the compound wall at Bhowanipore which was low afforded facility for the escape. This portion was raised to prevent further escapes. Of the two escapes at Berhampore one was captured and the other is still at large.

Observation Cases.

There were 104 cases under observation during the year, as against 63 in 1923; 65 of them were in the observation ward at Bhowanipore, 31 at Dacca, 6 at Berhampore and 2 at Gobra. Of these, 44 were certified as insanes and admitted into hospitals, 17 persons were released as uncertifiable, 33 persons, though certified as insanes, were released under Section 14, Act IV of 1912, 2 died and 8 remained at the end of the year.

Criminal Mental Patients.

There was a criminal population of 569 in the mental institutions, viz., 210 at Dacca, 356 at Berhampore and 3 at Gobra, as compared with 549 in 1923. Their daily average strength was 472·42, as against 453·97 in 1923. Sixty-two of them were discharged and 23 died. There remained, therefore, 484 criminal patients on December 31, viz., under trial 262, acquitted 140 and sentenced 82. Their crimes were murder in 214 cases, culpable homicide in 47, grievous hurt in 60, theft in 62, house trespass in 26 and other offences in 75 cases.

Private Patients.

Twenty private patients were admitted during the year 1924, as against 12 in the previous year, and 21 were remaining on January 1, 1924, as compared with 22 in 1923. Eleven were discharged, 2 died and 28 remained at the end of the year.

Finance.

The total receipts of the mental institutions (excluding those of the Gobra Mental Ward, for which no separate figures are available) amounted to Rs. 246,056, viz., Rs. 6,409 from fees of paying patients, Rs. 10,598 being the value of stores received from the manufacturing department, Rs. 200.413 being the receipts from the treasury and Rs. 28,636 being the book receipts. The corresponding figures for the preceding year were Rs. 317,228, Rs. 5,839, Rs. 8994, Rs. 215.654 and Rs. 86,741, respectively

The total expenditure amounted to Rs. 239,647, as compared with Rs. 311,389 in 1923. A smaller expenditure on buildings accounted for the decrease. The average annual cost per head of mental patients was Rs. 244-7-7, as against Rs. 327-3-9 in the year before.





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